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FIRST SESSION—THIRTIETH PARLIAMENT
1975

THE SENATE OF CANADA
PROCEEDINGS OF THE
SPECIAL COMMITTEE OF THE SENATE ON
SCIENCE POLICY

The Honourable MAURICE LAMONTAGNE, P.C., *Chairman*



Issue No. 1

WEDNESDAY, DECEMBER 3, 1975

First Proceedings on

The Study of Canadian Government and
other expenditures on scientific activities
and matters related thereto.

(Witnesses and appendices: See Minutes of Proceedings)



THE SPECIAL COMMITTEE OF THE SENATE ON SCIENCE POLICY

The Honourable Maurice Lamontagne, P.C., *Chairman*

The Honourable Donald Cameron, *Deputy Chairman*
and

The Honourable Senators:

Asselin	Hastings
Belisle	Hicks
Bell	Lang
Blois	Manning
Bonnell	Neiman
Bourget	Riel
Buckwold	Robichaud
Carter	Rowe
Giguère	Stanbury
Godfrey	Thompson
Goldenberg	van Roggen
Grosart	Yuzyk
Haig	

27 Members

(Quorum 5)



Order of Reference

Extract from the First Report of the Special Committee of the Senate on Science Policy, presented on July 10, 1975 and printed as an Appendix to the Minutes of the Proceedings of the Senate of that day, and adopted by the Senate on July 24, 1975:

"The Committee, therefore, recommends that it be authorized to consider and report on Canadian government and other expenditures on scientific activities and matters related thereto;

That the Committee have power to engage the services of such counsel and clerical personnel as may be necessary for the purpose of the inquiry;

That the Committee have power to send for persons, papers and records, to sit during adjournments of the Senate and to report from time to time; and

That the Committee be authorized to print such papers and evidence from day to day as may be ordered by the Committee."

Robert Fortier,
Clerk of the Senate.

Minutes of Proceedings

Wednesday, December 3, 1975.

(9)

Pursuant to adjournment and notice, the Special Committee of the Senate on Science Policy met this day at 10:00 a.m., the Chairman, the Honourable Senator Lamontagne, presiding.

Present: The Honourable Senators Belisle, Bonnell, Bourget, Cameron, Carter, Godfrey, Grosart, Lamontagne, Lang, Rowe and Yuzyk. (11)

In attendance: Messrs. Philip J. Pocock, Director of Research and Jacques W. Ostiguy, Chief of Administration.

The Committee proceeded to the consideration of its Order of Reference dated July 24, 1975 relating to the study of Canadian Government and other expenditures on scientific activities and matters related thereto.

The Chairman made an introductory statement. During his statement, the Chairman mentioned that a series of six letters and a questionnaire on future studies were sent to a number of senior officials of certain Government Departments, Heads of Crown Agencies and private organizations who have submitted briefs to the Committee during its first series of hearings in 1969. The Committee *AGREED* to print these letters and the related questionnaire as appendices to this day's Minutes of Proceedings and Evidence. They are printed as Appendices "1" to "7", respectively.

The following witnesses were heard:

The Honourable C. M. Drury,
Minister of State for Science and Technology;

Dr. M. J. LeClair,
Secretary to the Ministry of State for Science and Technology.

Mr. Drury made an opening statement. The witnesses then answered questions put to them by Members of the Committee.

(The brief presented to the Committee by the Minister of State for Science and Technology is printed as Appendix "8" to this day's Minutes of Proceedings and Evidence.)

At 12:45 p.m. the Committee reverted to an *in camera* meeting.

ATTEST:

Patrick J. Savoie,
Clerk of the Committee.

The Special Senate Committee on Science Policy

Evidence

Ottawa, Wednesday, December 3, 1975

The Special Committee of the Senate on Science Policy met this day at 10 a.m. to consider Canadian Government and other expenditures on scientific activities and matters relating thereto.

Senator Maurice Lamontagne (*Chairman*) in the Chair.

The Chairman: I would like to begin, so that we have the proper background for this new series of hearings, by making a short statement.

In an article published in September, 1975 in *Chemistry in Canada* entitled "The Politicians, are they really listening now?", Mr. Andrew Wilson, a science advisor to the Science Council, was complaining that:

Since the publication of the Senate committee's third volume two years ago the parliamentary science policy scene in Ottawa at least has been remarkably quiet.

Perhaps Mr. Wilson himself was not listening, because on July 10, 1975 our committee presented a report to the Senate in which it was seeking new terms of reference. This report was approved by the Senate on July 24, 1975. The new mandate authorizes the committee to consider and report on Canadian Government and other expenditures on scientific activities and matters related thereto.

In spite of the wide scope of this mandate, the committee has already indicated that it is intended to concentrate on three specific areas mentioned in its July 10 report:

First, we should make a survey of futures research programs being carried out within government departments and agencies and see how the Institute will develop its new area of activities...

Secondly, the committee should make a systematic review of the implementation of the recommendations contained in its report on science policy. In 1972 and 1973 we made about 73 formal recommendations and many more other suggestions. We know that many of these proposals have been accepted by the government but it is impossible to see how they have been implemented without meeting those who have that responsibility...

Thirdly, the committee should hold hearings on the Canadian science budget. In Volume 3 of our report, we recommended that the government present in an annual document its estimates of expenditures for scientific activities and that a committee of the Senate be authorized to make an overall review of those estimates. On February 28, 1974, the Honourable Jeanne Sauvé, who was then Minister of State for Science and Technology, announced that her ministry "will be responsible for the development of a science policy framework against which individual policies can be viewed" and that a science budget display "will be used for the evaluation of departmental and agency

budgetary proposals for scientific activity". The Minister added that "MOSST will evaluate these proposals prior to final consideration and approval by Treasury Board and publish annually a report analyzing federal expenditures on science and technology." The committee feels that it should scrutinize this report and consider how the new system of evaluation works.

Six eventful years have passed since the Special Committee of the Senate on Science Policy completed its public hearings. These hearings were limited by several factors. Canadians were not aware of the importance of science policy, and they did not fully perceive the specific issues involved. The data regarding expenditures on scientific activities were very scarce, and those then existing were very much out of date. In general, the members of the committee and the community of Canadians directly concerned with science and technology were coming to a major public discussion of the subject for the first time.

In the intervening years, not only have we all learned much more about science policy and the nature of its issues, but many related developments have taken place. The past six years have seen profound changes, not only in Canada but in most parts of the globe. Many of the changes of the past few years place a new and heavy burden on science policy making. New needs require changing priorities and new programs. Parliamentarians and government officials have new and challenging responsibilities. Probably the most visible and threatening changes involve future energy resources. The growing worldwide attempt to cope with this must take account of the increasing concern over environmental degradation and the depletion of non-renewable resources.

Other science policy issues arise from the many other changes or shifts of public perception. To name only a few: food needs and nutrition; climate changes and weather modifications; alternative technologies versus established technologies; the safety of nuclear power plants; resources within and under the oceans; genetic modifications; human and environmental protection. With these problem areas are associated opportunities and threats. Hence, conflict is unavoidable and consensus making is required for any action to be taken in response to the new and changing matrix of problems. Lack of concerted action in the face of problems does not avoid future changes. It simply results in our future being shaped by force and accident rather than reflection and choice. We need a policy for accident, not a policy by accident.

Realizing new policy responsibilities is not equivalent to changing policies and formulating new objectives and programs. The gap between the perception of new policy needs and the development of, say, satisfactory technology delivery systems is worrying and frustrating public spokesmen, parliamentarians and government officials the world over. Canadians are not alone in having to face the problems of bridging this gap. Members of the committee

are among those who are concerned about the gap between the perception of a new need, opportunity or threat and the development of a response which effectively utilizes the output of our knowledge-producing institutions. Science policy, among other things, should be designed and implemented to reduce this gap.

During the past six years there has been a growing appreciation of the need for institutions and individuals to become sensitive to change, to develop abilities and strategies to cope with change and environmental turbulence. The creation within the Canadian government of the Ministry of State for Science and Technology was certainly one of the main results of this growing appreciation.

In order to prepare for this new series of hearings, on September 17 I wrote, as chairman of the committee, to Dr. Maurice LeClair, Secretary of the Ministry of State for Science and Technology, and to Mr. Shepherd, Executive Director of the Science Council of Canada, asking their respective organizations to prepare briefs in the light of the committee's specific interest in science policy. On September 23 I sent a similar letter to all deputy ministers of government departments and heads of crown agencies. I also communicated, on October 14, with all private organizations which had submitted briefs to the committee during its first series of hearings in 1969.

With respect to the more particular area of futures studies, on October 17 I sent to all government departments and agencies another letter, accompanied by a questionnaire. I also communicated, on October 24, with a few private organizations which, to our knowledge, have developed a special interest in futures research.

Thus, six different letters and a questionnaire on futures studies were sent out. I believe it will be useful to have these documents printed as an appendix to today's proceedings so that they will be part of the public record. I hope the committee will approve this.

Hon. Senators: Agreed.

See Appendices 1 to 7, (pp. 21 to 41).

The Chairman: The members of the committee agreed at the previous meeting that this new series of public hearings should be inaugurated by the Ministry of State for Science and Technology. This was only natural, since the Ministry has a major responsibility as a central agency within the Canadian government for the formulation of broad science policies and a review and assessment of all proposed science expenditures.

Mr. Drury, the members of the committee are pleased that you are able to appear before them this morning in your capacity as Minister of State for Science and Technology.

It has been the practice of this committee to print the briefs submitted to us as an appendix to our proceedings instead of having them read here. It has also been our practice to invite our guests to make a short opening statement, if they so wish. Therefore, Mr. Minister, if you have anything to add to your brief we will listen to you with great interest.

The Honourable C. M. Drury, Minister of State for Science and Technology: Mr. Chairman, senators, I have been most impressed by the record of performance of your committee. I would recall to you that it is some seven years since I last appeared before this committee. I did so then in my capacity as Minister of Industry. The subject we dis-

cussed at that time was the government's intention to develop a communications satellite system. I think you will agree that that particular program has been a marked success, but it does indicate how long it is from the genesis of plans or ideas to the actual accomplishment of them and the possibilities of making, in a sense, an after-the-fact study of whether a plan has been successful or not.

When I appeared at that time you were just beginning your hearings and had before you many months of hard work. No one can doubt the thoroughness with which you approached your task. I think it is fair to say that no other investigation of science policy anywhere in the world has equalled that carried out by your committee. Your report has constituted a significant background to all discussions of science policy matters, and its influence will continue to be felt not only in Canada but, I suspect, also internationally.

You are now addressing yourselves to a review of the situation that has evolved in the years following the publication of your report, and you are quite reasonably concerned to establish the extent to which your recommendations have been acted upon.

Your choice of the Ministry of State for Science and Technology as your first witness was hardly unexpected. Your report dealt extensively with the role of the ministry, and the history of Canadian science policy over the past four years is inextricably bound up with the birth pains and growth of MOSST.

Many of your recommendations were addressed to the government as a whole rather than to the science ministry, and although the ministry has contributed its advice, the decisions by the government on action to be taken naturally took into account inputs from other sources as well.

It is my view, therefore, that the brief to your committee should be submitted by me as a member of the government and that I should meet personally with your committee. In calling on my ministry to provide a brief you have asked us to comment on a wide variety of issues. We have attempted in our written brief to handle your questions in two ways: those questions that relate to MOSST, its history, structure, procedures and programs, have been dealt with from the ministry's point of view; while those issues that are broader in nature I have commented on from a general government point of view.

We have in our brief tried to place the policies, decisions and events of the past four years in perspective and to identify wherever possible the influence that your committee's report has had. There are certain matters, such as the relationship between MOSST and the Treasury Board, that I know to be of specific concern to you, but I do not feel that I should try at this stage to pick out specific issues or attempt to summarize orally the material that is in our brief. I propose, if it is acceptable to you, to let the document speak for itself and to respond to questions on those particular matters that you or the members of your committee may wish to raise.

The Chairman: Thank you, Mr. Minister. At a previous meeting of the committee I asked members to indicate to me whether they wanted to put questions to the minister. The first three members of the committee to approach me were Senators Grosart, Carter and Lang. I will therefore recognize them in that order, to start with. I also propose that we should follow the procedure we used when we held our first series of hearings, at which time we allowed a member of the committee to put at least his main questions

without interruption. I am sure that all of the other members of the committee will have ample opportunity to ask their questions later. I believe this procedure is much more useful in the sense that it allows for more continuity of debate and discussion than if a member is interrupted in the process of his questioning. Is that agreeable to you?

Hon. Senators: Agreed.

The Chairman: Senator Grosart, will you begin the questioning?

Senator Grosart: Thank you, Mr. Chairman.

Mr. Minister, May I add my words of welcome to those of the chairman? I am always glad to see you in this or other committees. I also wish to thank you, firstly, for the nice things you said in your presentation about the committee's work and also in your remarks this morning; and, secondly, for the interesting rundown you have given us of some of the areas in which the government has implemented recommendations of the committee. I also appreciated your explanations of those areas in which, for various reasons, recommendations of the committee have not been implemented. We did not expect that all our recommendations would be implemented, but I am sure we are all thankful for the degree to which they have been.

Finally, I wish to thank you, Mr. Minister, for your preview of the intentions of MOSST in its future activities, which brings me to my first question, relating to an article which appeared in the *Ottawa Citizen* on Monday. The article said that the federal cabinet is facing proposals for massive cuts, et cetera. The article says "truly Draconian ones," quoting somebody, and one of the matters that it says is being discussed by the committee is the phasing-out of the Ministry of State for Science and Technology over 12 months and a freeze on all research spending and many other grant programs. My first question is, therefore, are we working with the still-breathing corpse or a dead one?

Hon. Mr. Drury: Neither.

The Chairman: Can you explain that?

Hon. Mr. Drury: The term "corpse" is a corruption of a French word and is rather inappropriate.

Senator Godfrey: Particularly with regard to one that breathes!

Hon. Mr. Drury: MOSST has recently gone through a period of re-organization and restructuring, looking to a productive existence now and in the future. The story that appeared in the *Citizen* I can only classify as a complete canard—a duck.

Senator Grosart: I am very glad to hear that. Now we know that our hearings can continue. We had some doubts about it when we read that article.

The first question I would ask you, Mr. Minister, is with regard to what has been called by somebody, "the silly semantics" of the arguments about the role of a co-ordinating or concerting body in science policy. "Silly semantics," as it has been called, involves the argument as to whether it is "science policy" or "a policy for science". Your deputy has used this argument to explain certain shortfalls in the current role of MOSST, and I think you have allowed yourself to fall into the same trap on one or two occasions.

The reason I ask this question is that there is some indication of a deterioration of the role and activities of

MOSST over a period of time. I seem to have reached the conclusion that this may be due to the strawman that has been set up. Is it "science policy" or is it "a policy for science"? I will not quote the occasions on which this argument has been developed. I only say this: Is there any sense in it at all? We do not talk about whether we have a "trade policy" or a "policy for trade," or an "immigration policy" or a "policy for immigration," or "a monetary policy" or a "policy for money." What is the sense of trying to make this distinction as an argument in favour of MOSST, not doing the full job that we recommended it should do?

Hon. Mr. Drury: When one talks about "silly semantics", I think, really, it is in an endeavour to get a clearer understanding of how to answer the question, "What is our science policy?", and to indicate that the answer is not a simple one, any more than it would be if the question were, "What is our trade policy?" We no longer ask the question, "What is our trade policy?". We got over that difficulty a long time ago, and now talk about specifics. Perhaps we have not yet succeeded in getting over what you call the "silly semantics" hurdle, nor in recognizing that a one-line phrase will not suffice to describe a science policy.

Philosophically, I hold the view that science and technology, whether in the natural field or the humanities, are good and worthwhile to the extent that they can serve to resolve some of the problems the larger, so-called social problems, or national problems—that we face, rather than to the extent that science should exist for and in itself. There is in my mind a great deal of doubt about this. We have seen the decline of religion in the world, not because religion as such is any less virtuous than it used to be, but perhaps rather because it has been less useful in recent times in providing solutions for the growing problems that face us than it used to be. As a consequence, it has been in decline. One really should look at science and technology in the same way, and the measure of support for and faith in them should have a direct relationship to their usefulness in solving problems rather than to science and technology for their own sake.

If one looks at the subject this way, then the whole approach to so-called science policy becomes one of, "Where and how can science and technology be helpful?" If they can, they should be supported. If they cannot, they should not be. Therefore, while a view of science and technology as being capable of solving problems, in my view, will get you a rational, viable state of science and technology, supporting them merely for their own sake, because this is merely an act of faith, is liable to fail.

My own understanding of the history of science and technology if I can use this term, in the years immediately following the war, has been one of blind faith in and reliance on science and technology as being likely to provide the answers to all our problems. It takes time to discover such answers, and we have not gone as fast in resolving our problems as perhaps people hoped for. Consequently, there has arisen a disenchantment with science and technology as being the universal answer to everything. Here, the test of usefulness of their contribution to the solution of social problems has been applied, and we have not, in the scientific field, been able to provide satisfactory answers.

I would suggest that our task is to re-establish the place and usefulness of science and technology. We should address ourselves, really, to a hard calculation of likely useful results rather than merely saying, "You must give,

you must contribute, you must make available, resources for science because it is a good thing, because it is important."

Senator Grosart: Surely, all that would apply to energy policy, or immigration policy, or agricultural policy? We have set up separate departments to deal with all of those things, but they are all-pervasive, just as science is, and everything you have said about science applies to energy, or to immigration, or to manpower or anything else. I do not understand why MOSST appears to be putting so much reliance on what appears to me to be a pulling back from the essential role of co-ordinating and to some extent, concentrating science policy. What I find difficult to understand in the presentation you have made, or that the department has made, is that over and over again you say that you are doing exactly this. You say, "We are assessing and reviewing . . . We are getting a visible science budget." This is in your report. Somewhere else—perhaps in the speeches—you say, "We must not have a visible science budget prior to the time that it goes to Treasury Board." Yet, throughout this presentation you say, "We are doing this." I do not understand why MOSST is trying to pull away from this. Perhaps you will be able to tell us in this committee meeting today why MOSST is deprecating its own role so continuously. You have done quite a bit of it yourself.

Hon. Mr. Drury: Yes. One has to be rather more specific about the charge, if I can call it that, of deprecating one's own role. I suggest that anything I have said, or that the brief says, is not deprecating our role, but trying to give effect to the notion that science and technology are, as you put it, all-pervasive and the opportunities for their useful employment exist every where and in every face to four life, but in relation to the solution of non-scientific or non-technical problems. When one talks about co-ordinating and a science budget, if this conveys a notion that quite independently MOSST should be running a series of scientific or technological exercises unrelated to the specific needs of individual government departments or agencies, then we would have departments or agencies operating for the betterment of science, whatever that is.

Senator Grosart: But, surely, that does not follow?

Hon. Mr. Drury: Our view is that if one takes a particular department, let us say Agriculture, you find there they have a series of problems. Some of these problems can be resolved by the application of existing scientific knowledge, and some may be resolved by the application of future or hoped-for or anticipated scientific knowledge. Others really cannot benefit from the application of either science or technology. The Department of Agriculture puts a priority on the resolution of these particular problems, and some are urgent and some are less urgent, some are important and some are less important; but the priority is not a scientific or technological one, it is basically a national one in terms of our national goals. The role of MOSST should not be the determination of these priorities of the Department of Agriculture, but to see that to the maximum possible extent useful technological and scientific help is given in the resolution of these problems. Inevitably in any department there will be a tendency to look at one's self in perhaps a fairly circumscribed field. It is to be hoped that from the outside MOSST can, with its wider knowledge of what is happening in other fields—that is to say, fields other than agriculture—provide assistance. It can also provide administrative assistance to the

department or to the technological or scientific elements of the department, with a view to ensuring that administrative arrangements, based on experience elsewhere, are perhaps more effective and more efficient than otherwise they would be.

Senator Grosart: Would you agree, Mr. Minister, that they should be an essential part of a policy for science, or to use a phrase you used in the presentation, a framework for science policy? Some place in the government's decision-making process decisions have to be made to deal with the adequacy or inadequacy of the total spending on science as a percentage of the total federal budget, yet you seem to say that you do not like that, you do not like it considered as a percentage of the GNP. Would you agree that there should be somewhere in government a review and assessment, prior to the spending of money on science and technology, of the adequacy of the total, the distribution by performance, the distribution of that money by various categories of science, for example, as between basic and development (something that for some reason or other is not broken down in any way in the Green Paper) the percentage of total government spending distributed as between R&D and what are called other related activities, between departments, between the natural sciences and the humanities and so on? Would you agree that somewhere, before the money is spent, there should be a review and assessment and advice given to the government as to the total package of scientific and technological spending—that is, the public money spent in this area? Should it be looked at before, or should it be looked at only afterwards, as we are doing now?

Hon. Mr. Drury: We do endeavour to collect information as to the types, location and purpose of spending in the scientific field. But this analysis is made with a view to determining where the gaps are, where the successes are and where the failures are, rather than assuming that if in some way or other we can spend twice as much money on science, then we are going to be better off in some fashion, or that by spending half as much on science as a whole, we are going to be better off. If I may come back to the purpose that we would like to see science and technology serve, it is the solution of problems. If we have problems in an area where scientific and technological tools exist, or are in likely prospect, one would then expect scientific and technological expenditures to rise in seeking these solutions or in their application. If, as a country, we perceive that our problems are in areas where science and technology cannot be of much help in resolving a problem, then one would expect, as we address ourselves to those and try solutions, that scientific and technological effort and expenditures would decline as a proportion of the total.

In Canada, if one looks at the federal budget over recent years there has been a very substantial increase in expenditures by the federal government under the heading known generally as transfer payments. For the resolution of a number of our social and economic problems, the conclusion has been reached that in a society where we believe the maximum freedom of choice to the individual should be our aim and rule, a number of these social problems, inequalities and injustices, can be cured by putting economic resources in the form of dollars in the hands of individuals and letting them make their choices. This means that federal expenditures on transfer payments, particularly to individuals, have risen proportionately very largely indeed. That is where the money resources are going.

Because this is not an area in which science and technology can offer much help, or where a mobilization of scientific and technological resources will make for a better solution, the expenditure for science and technology as a proportion of the total would be expected to decline. This does not mean that we are of necessity following the wrong course, that as we increase expenditures on transfer payments we should automatically increase expenditures on science and technology. The two are unrelated. This is the difficulty about saying we should have some magic number as a proportion of our total expenditures under the heading of science and technology.

The total expenditure in this field is the sum of a great many individual expenditures, each of which is justified in its own right. By way of example, if we take larger numbers, under the heading of what might be called big science we have been going through a period of development of a technique for producing electrical energy by nuclear fission, known as the CANDU system. This has now reached a stage at which large expenditures are being made in the production and installation of hardware, and actually operating it, which means that in relation to nuclear fission the period when the proportion of the total expenditures devoted to research and development were dominant is now over, and consequently they are declining as a proportion of the total. One would expect that; it is logical.

At the same time, we have entered into a new field, on quite a massive scale, of communication satellites, where fairly substantial expenditures are taking place on the research and development side. We have not yet got to the production costs. During this subsequent period one would expect the research and development proportion of the total to decline. This sequence indicates the problem of saying that a proportion of total expenditures must go to science and technology in every case. In a sense, we have to look at the sum of a whole lot of individual expenditures, which gives the total expenditure.

I do agree that when we do the arithmetic—and we have got the means of doing this arithmetic now, thanks to computer systems—the experience of our own and other countries indicates that if of the total of national effort no expenditures on science and technology are being made, this is not the apparent formula for a successful industrial society, which we are, so that it is an indicator without, however, being a target.

The Chairman: Since the minister does not have too much time available this morning, I wonder if the questions could perhaps be a little more specific and the answers a little bit shorter.

Senator Grosart: Let me take a specific and see how this philosophy is working out. Let us take this whole question of the funding of R&D or science activities in industry. I recall that many years ago the committee quoted you in our first report. In October, 1967 you said, referring to government policy, that our "first obligation" is to ensure that technological innovation activity in our industry is brought to a competitive level in the shortest possible time. That, of course, was said in 1919 in more or less the same language at the time of the Cronyn Committee. This is announced government policy, and it has been restated by yourself and others over and over again.

The fact of the matter is, in spite of that policy being announced and being reiterated over and over again, the percentage of government funding in science activities in industry is declining. You ask us in your presentation to

look at the publication "How Your Tax Dollar is Spent". Perhaps I might comment that I find your reference to that extraordinary. In this document it is one chart and half a page. This is the overview we are to look at. We are told this is the evidence that there is this real assessment and analysis going on. That is the statement made. It also tells us that in 1970-71, two or three years after your statement, the percentage of federal budgetary expenditures on science in Canadian industry was 18.5; in 1971 it was 17.1 per cent; in 1972 it was 16.5 per cent; in 1973 it was 16.7 per cent; in 1974 it was 15.6 per cent; and, projected in the main estimates this year, it is 15.7 per cent. In your presentation we have a great deal of talk that you have really carried out this policy because you have set up the make-on-buy policy—and I will ask a question about that in a minute.

Can you explain why, when this has been stated over and over again as government policy, that the government has not in fact been able to break through whatever it is, this monolith of resistance, so that the actual funding in industry today is declining, and has been declining for years? How do you reconcile that with the approach that you have just given us as the ad hoc type of approach that you think is better than on overall planned approach?

Hon. Mr. Drury: I am sorry if I have conveyed the notion that the approach is ad hoc rather than planned.

Senator Grosart: I think that is exactly what you said, because you said that we take each department and let it do its thing; that then we add up the figures afterward and publish them in "How Your Tax Dollar is Spent". That seem to me to be ad hoc. I do not want to be unfair. I was not using "ad hoc" in a pejorative sense, but I was using it in a descriptive sense.

Hon. Mr. Drury: Mr. Chairman, on the particular table, which I haven't in front of me, are those percentages of federal budget or what?

Senator Grosart: They are budgetary expenditures as a percentage. There is nothing new in this. You say this over and over again. We have statements over and over again here that it is declining. I can refer you to some others, if there is any doubt about that one.

Hon. Mr. Drury: Well, without trying to make clear what figures we are talking about, it is a fact that, in the past some four years, Canadian industry has been spending a lower proportion of its own resources on research and development than it did at an earlier period shortly following the introduction of industrial incentives for this, about which I was talking the last time I appeared here as Minister of Industry. These did produce a growth in the proportions of total industrial resources devoted to research and development within Canadian industry. Since then it is quite clear that the attraction or the effectiveness of these incentives has declined, with the result that the proportion of total resources devoted by Canadian industry to research and development has gone down in relation to their total expenditures.

As the government incentives become less attractive, government outlays in paying for these incentives decline. One would expect that. The demand has gone. We are currently not only aware of this, conscious of the fact that this is undesirable, certainly in the long run, but are reviewing in depth—and this is one of the jobs MOSST has—the whole gamut of assorted incentive programs designed to increase the proportion of total resources devoted by Canadian industry to research and develop-

ment. Part of them relate to purely technological considerations; part of them undoubtedly relate to the general corporate structure and its relationship, parent and subsidiary relationship, with foreign countries. What I can probably safely say is that the incentive programs we have had are losing this earlier effectiveness and we have to put some new thought into this.

Senator Grosart: Is it still the intention to increase federal funding of science activities in industry as against the intramural percentage of around 67 per cent?

Hon. Mr. Drury: It is our intention to get Canadian-based industry to increase its proportion of total resources going to research and development, and part of that will undoubtedly lead to the need for the federal government's funding in whole or in part—well, in part—some of this increase. In some instances it will be the funding of a whole research operation or development operation; in other cases it will be a relatively small part. But until we can get Canadian industry to make use of, usefully make use of, additional resources, it would not be the intention of the government merely to spend for the sake of spending, if I make myself clear. Increased spending should be a result, not a purpose.

Senator Grosart: Is it not the government's policy to increase the capacity of industry to absorb funding for R&D and other science activities? Or are you just going to wait until the industry does it?

Hon. Mr. Drury: The answer is "yes". Unless it can usefully absorb, there is no use spending the money.

Senator Grosart: But, surely, that is what policy for science is all about: the responsibility of the government to see that industry does upgrade its innovative capacity? You yourself have drawn attention to the fact that our deficit on technological exports and imports has increased from \$1.5 billion, back a few years ago, to something like \$5 billion or more today. Is it not government policy to do something about this?

Hon. Mr. Drury: It is, and I think I just said that we are conscious of the fact that our innovative programs are not now producing the same relative results they have in the past. The purpose of the make-or-buy policy is just that.

Senator Grosart: May I ask you how many dollars have been transferred from intramural government science funding through the Make-or-Buy policy into industry? Not the whole business. We have a figure of \$19 million out of a total federal budget of something like \$1.4 or \$1.5 billion. Nineteen million! A large portion of that had not gone to industry at all, as I understand the statement of these transfers in Supply and Services announcements. Now, how much has actually been transferred through the make-or-buy policy into industry?

The Chairman: As compared with the situation before the policy was formulated.

Hon. Mr. Drury: It is a little hard to say how much has been transferred. The answer to this would require an analysis of each outside contract, and a determination of whether it was something new, or whether it actually had been transferred from a previous activity of some government or intramural operation, or an outside operation. I really cannot answer that.

Let me say that with regard to mission-oriented research and development expenditures, in 1970-71 we were spend-

ing \$223 million, roughly, intramurally, and \$10 million in industry. In 1975-76 the figures were \$317 million intramurally, and \$50 million-odd in industry. The intramural figure has gone from \$223 million to \$317 million, and the industry figure has gone from \$10 million to \$50 million.

Senator Grosart: But the percentage is still 14 per cent, which is where it was in 1967. That is, the percentage of the total. I am now quoting from page 7 of the green book.

Hon. Mr. Drury: If you do the arithmetic on the figures that I have just given, expressed as percentages the percentage in industry in 1970-71 was 4.5, and in 1975-76 it is 13.7.

Senator Grosart: What is this in?

Hon. Mr. Drury: Mission-oriented research and development expenditures, intramurally, that is, within the government, as against industry.

Senator Grosart: But the total is still 14 per cent, after ten years. Here is the statement. It is as clear as can be. On page 7 you analyze it and you say exactly what it is. I have given you the figures. Your current in-house figures for 1967, for universities and NPOs—that is, non-profit organizations—is 15 per cent, and for industry, 14 per cent. This is a statement in MOSST's analysis. It is still 14 per cent, which is where it was in 1967, in spite of all of these statements, over and over again, that this is a priority, that this is government policy. I am suggesting to you that the government, having indicated that this is a priority policy, has not been able to break through departmental resistance.

Hon. Mr. Drury: You are ascribing a motive here, and I would take exception to that; but I do acknowledge that in spite of the numbers I have given you, for 1970-71 and 1975-76, as showing an improvement—quite a marked one—there was a decline between 1967 and 1971. The percentages declined, but they are now rising.

Senator Grosart: Not according to the figures in the reference you gave us in "How Your Tax Dollar is Spent". This shows that the total percentage of government funding of science activities in industry is still declining.

Hon. Mr. Drury: You say it is still declining. The proportion of research and development expenditures by the federal government in relation to its total budget has been declining?

Senator Grosart: In relation to its total science budget it is declining. That is the point I am making.

Hon. Mr. Drury: With this I beg to differ. Perhaps I can read to you the percentage of federal government expenditures in industry by year as proportions of the total mission-oriented expenditures.

Senator Grosart: I do not know why you make that distinction. It is not mission-oriented. It is only one part of the total government policy in respect to science. Let me read you this from page 29.

Hon. Mr. Drury: I use the term "mission-oriented". You call it "silly semantics". We do make quite large expenditures, however...

Senator Grosart: I did not call it "silly semantics".

Hon. Mr. Drury: — in support of curiosity-oriented operations, most of which go to universities. That has nothing

to do with this at all. If you wrap them all up in one global figure you are going to get confusion.

Senator Grosart: I must say this is adding to the confusion, because here is a statement on page 29: "Support of the industrial sector has increased at an average annual rate of 6.2 per cent since 1973, slightly less than the growth of intramural expenditures (7.8 per cent) but greater than that of the university and non-profit sector."

You make this statement over and over again. When you make such a statement in such positive terms so many times, it is, I think, begging the question to come along and take one section of the expenditures and say, "It has not happened here." Of course it has not happened everywhere, but we are talking about an overview and an assessment of the validity of total government funding of science and technology. That is what we are talking about. We know that in various sectors the figures are not going to be the same all the way through as they will be in the total figures; but we are talking about government policy with respect to spending public money. Is it planned, or do these things happen by accident? Was it planned that the percentage of total funding in industry would decline, or is this a matter of accident? Are we still achieving government science policy by accident?

With that I pass, Mr. Chairman.

The Chairman: I think we should try to discuss the same figures.

Hon. Mr. Drury: Yes.

Senator Grosart: I am taking the figures you referred us to. I am not making figures up. I have read them out of the green book, and I have read them out of the book about how taxes are spent, which is the source you referred us to in your presentation. I cannot go beyond that.

Hon. Mr. Drury: In a sense, Mr. Chairman, this is becoming a dialogue of the deaf.

The Chairman: I agree.

Senator Grosart: That is what we have been complaining about ever since we started these hearings.

Hon. Mr. Drury: You say that the federal government's expenditures in industry have declined.

Senator Grosart: From 1973. They were more or less uniform before that, but according to your source they were then 18 per cent. Now they are 14 per cent.

Hon. Mr. Drury: Government expenditures in industry?

Senator Grosart: Yes.

Hon. Mr. Drury: This is something I can understand, but I think you are wrong. By "1970" you mean 1970-71. I will give you the precise numbers.

The Chairman: You are speaking about mission-oriented figures now. You see, we are not discussing the same figures.

Senator Grosart: They are not in this publication, nor is there a breakdown between basic figures and the ones in here. I am referring to the figures you have quoted, and nothing else. I am not quoting any other figures; I did not make them up. I got them out of the publications you referred to in your presentation to the Committee.

Hon. Mr. Drury: The problem here is what you referred to as "silly semantics."

Senator Grosart: I said "silly semantics" in relation to this argument about "a policy for science" or "science policy." I did not go beyond that. It is not silly semantics to break down and discuss them. I do not call that silly semantics.

Hon. Mr. Drury: We have endeavoured in this book to classify rather extensively various kinds and definitions of scientific expenditure. There have been included both research and development, and a rather larger category known as science related expenditures.

Senator Grosart: A smaller category.

Hon. Mr. Drury: Smaller quantitatively, but broader than just research and development.

Senator Grosart: Smaller in funding. It is 62.7 per cent in R&D and 37.3 per cent in Related Science Activities.

Hon. Mr. Drury: When one is talking about the numbers you have been giving, you are including the science related expenditures.

The Chairman: This document you are now reading from, we do not have it. I wonder if it would be possible for you to make a copy available to the committee.

Senator Grosart: I am talking about all federal funding for science activities. That is your own phrase again.

The Chairman: You do not make these distinctions in your green book, so Senator Grosart is discussing this on the basis of the figures we have, while you are discussing it on the basis of the figures that we do not have. If you could make this available to us, then I think it would be of some help.

Senator Grosart: We will forget it for now.

The Chairman: We will come back to it later, and I am sure you will have further questions to ask later on, Senator Grosart.

Senator Grosart: Mr. Chairman, we will resume the dialogue of the deaf at another time.

Hon. Mr. Drury: I might just point out that if one looks at page 34 in the book that Senator Grosart has . . .

Senator Grosart: That is R&D only.

Hon. Mr. Drury: This is R&D only; but these are the numbers I was giving.

The Chairman: But you were speaking about mission-oriented.

Senator Grosart: That is right, an entirely different thing.

The Chairman: Within R&D you were speaking about mission-oriented programs—not total.

Senator Grosart: Let us leave it for now. Maybe MOSST can come up with some answers to that later.

The Chairman: Could we have that document?

Hon. Mr. Drury: You cannot have the whole thing, but you can have the table. It is rather a thick internal document relating to other subjects.

The Chairman: Well, we do not want to know all your secrets.

Senator Carter: Mr. Chairman, I hope you will permit me to make a brief preamble to my question. It will be short. I have compiled my own definition of science policy because this is the framework in which I want to pose my questions. Like Senator Grosart, I found the semantics somewhat disconcerting because I found that there was some confusion or, at least, a lack of clear distinction in the minds of the officials, or possibly the minister—whoever worked on the brief—between science per se and science policy, and that accounts for these straw men that Senator Grosart referred to. That confusion is carried over into the ministry's own definition on page 5, where it states that "the Cabinet has now agreed that Federal Government science policy includes the sum of policies in three distinct areas." This is still the sum of policies in the area of science—and I could spend 15 or 20 minutes arguing about science and technology and engineering because apparently science, as they have defined it here, includes technology and includes engineering, which are three entirely different things.

The point I want to make to the minister is this, that you cannot avoid having a science policy. Even though you may say that "science policy" is not a meaningful concept, it may not be meaningful to you, nevertheless you cannot avoid having some science policy because even the absence of a science policy is in itself a science policy. There is nothing in this definition, and there is nothing that I could find in your brief based on your definition to show that we have got away from a science policy by accident, which is what we are trying to avoid and what the whole burden of the committee's recommendation was trying to avoid. But there is nothing here to show me that these policies in these areas are still not policies by accident, and it seems to me that what has happened is that you have taken the policies already in existence and repackaged them in three parcels and called them "science policy in three areas". For that reason I have compiled my own definition of science policy and it is this: Science policy is a planned course of action to acquire and to use scientific and technological know-how in the solving of problems and the attainment of goals in such a way as to secure maximum value for the dollar spent.

Now, Mr. Chairman, the committee conducted an extensive inquiry and it found, amongst other things, a number of shortcomings. In the first place there was no science budget, and it was difficult—impossible—to assess even government expenditures which were in the hundreds of millions of dollars and possibly up to a billion dollars. When it came to the private sector, it was even more difficult. Furthermore, the committee found that the distribution of scientific effort as between government, universities and industry was quite different from that of other industrialized countries and our competitors. We found also that government, university and industry activities were three solitudes—they were not talking to each other. No one of them was familiar with what the others were doing. We also found that there was no inventory, no way to identify what was being done or what overlapping existed. There were no criteria for the assessment or evaluation of projects or for reviews with the object of discontinuing useless projects, or projects that had already outlived their usefulness. There was no planned course of action directed to solving specific problems. There was no assessment of return on our R&D

dollar, and millions of dollars were wasted on R&D, which were chopped off at some stage short of innovation and not carried to the ultimate stage of marketable products.

The committee having found that to be the situation, the new department was set up. If I were minister, this is how I would proceed with the situation. I want to list a number of things that I would do, and I would ask the minister what he has done.

The first thing I would expect the minister to do would be to find out what dollars were available, because that is our framework. The three elements of our framework are dollars available, the problems to be solved, and the organization and procedure for solving them. The first thing would be to find out what dollars are available now and in future years.

Secondly, I would see how the dollars available compared with other industrialized countries, particularly those of our competitors. For comparison, I would suggest the top ten of the OECD countries, or even the smaller countries, Norway, Finland, Denmark and other countries of that nature.

Having identified the discrepancies, I would expect a plan to be developed to correct the discrepancies. That would mean a planned budget over a period of years, to increase our budget to take care of the discrepancies, or to reallocate the distribution of the dollars.

I would then check the distribution of the scientific dollar in Canada among the universities, government and industry, and again make a comparison with the distribution in other countries. Whatever discrepancies were found, I would expect steps to be taken to correct them.

Next I would compile a list of problems or goals. After that I would compile an inventory of the R&D effort in Canada, from which I would make a selection of priorities. For example, one of our big problems today is unemployment; we have seven per cent unemployment. Job creation should surely be a top priority, and one of the best ways of creating jobs is through innovation, new marketable products.

Finally, there would be a criterion for selection assessment, evaluation and review, and discontinuance, if necessary, of projects that are either unnecessary or have outlived their usefulness.

The Chairman: I am glad, senator, that you have arrived at your final point.

Senator Carter: I want to start by asking the minister what he has done on each of these. What dollars are available now, and what dollars do you see available, say over a period of five or ten years? What is your planned budget, or is there one?

Hon. Mr. Drury: There is not one.

Senator Carter: There is not?

Hon. Mr. Drury: So I have failed.

The Chairman: You have failed the first test.

Hon. Mr. Drury: That is right. You say that one of the best techniques for job creation is the innovation of new marketable products. Let me recite an experience with which most Canadians are familiar. Largely as a consequence of the government making resources available, we

assembled a highly competent technological and manufacturing team, backed up by more than adequate designers, and turned out an item known as the Avro Arrow.

Senator Grosart: I thought you were going to say STOL.

Hon. Mr. Drury: That, by popular assent, was the most advanced and most economical fighter-aircraft of its day. Here was a convincing demonstration that Canadians, following your prescription . . .

Senator Carter: You have got lost.

Hon. Mr. Drury: I am not lost.

Senator Carter: I said "marketable products." That was not a marketable product.

Hon. Mr. Drury: Wasn't this a marketable product?

Senator Carter: You didn't market it.

Hon. Mr. Drury: I agree.

The Chairman: You have failed the second test.

Hon. Mr. Drury: This was the failure, marketing. It had nothing to do with innovation. You can latch as many dollars as you like on innovating and produce the most glorious products, but if you cannot market them it is all wasted.

The Chairman: It is not an innovation then.

Hon. Mr. Drury: It is an innovation.

Senator Carter: No.

Hon. Mr. Drury: It was an innovation.

Senator Godfrey: It is nothing new.

Senator Carter: When the minister says there is no budget, am I to understand that we do not know, that we are in the same position as we were when we made our report, that we still do not know how much is being spent in Canada in the public sector and the private sector on scientific effort?

Hon. Mr. Drury: Yes, we do know. Indeed, there is this kind of document, "Federal Scientific Resources."

Senator Carter: I know you have \$1.4 billion on the government side. What about the private sector? Do we know?

Senator Grosart: That is GERD—Gross Expenditures on R&D.

Hon. Mr. Drury: If one assumes the universities to be the private sector, we know what the universities are spending. We also know what industry is spending.

The Chairman: For what year?

Hon. Mr. Drury: Unfortunately the statistics suffer from a time lag, like all statistics, and it would be at least a year, or more like 18 months, before we get unanalyzed, raw information.

Senator Carter: Have you made a comparison with the other industrialized countries, particularly our competitors, in terms of GNP? How does Canada stand compared with the top industrial countries of Europe, or even with the second level countries such as Norway and Sweden?

Hon. Mr. Drury: Rather than take the so-called top industrialized countries of Europe, the matrix I would look at as a whole are the members of OECD, which would seem to be more appropriate. It includes both the United States and Japan. Right now, as a proportion of gross national product, we are approximately ninth out of these ten OECD countries.

Senator Carter: We are ninth down the ladder? WE are ninth from the top?

Hon. Mr. Drury: Ninth from the top, yes.

Senator Carter: Is that what you are talking about?

Hon. Mr. Drury: Yes.

Senator Carter: Do you regard that as a satisfactory situation? Are you satisfied with that, or are you taking steps to improve it?

Hon. Mr. Drury: We are not satisfied with that. As one topic indicated, we are endeavouring to make effective a make-or-buy policy, the object of which is to increase the innovative capacity of the Canadian manufacturing industry. It is in this field that our divergence from the OECD pattern generally is greatest. The amount of money we are spending, as a proportion of GNP, in the universities compares quite respectably. Our ranking is quite different in that respect in the OECD countries.

The Chairman: And in government.

Hon. Mr. Drury: This, then, is not the principal area in which there is catching-up or improvement to be made. By comparison with these same countries, the proportion spent within government, although not as high-ranking as the universities, is still not a source of worry. It is the industrial sector which is the source of worry. As Senator Grosart pointed out, and with which I agree, we have not achieved an outstanding success in improving the industrial sector, compared to the success we had in 1967, if you go back to the early 1960s. And we have also been improving since 1970-71, when we went into a trough.

Senator Carter: But even today our distribution for the industrial sector is only about one-third that of our competitors. Is that not correct? We are spending about one-third in the private sector or industrial sector compared to two-thirds in the other OECD countries. That was the point Senator Grosart was making.

Senator Grosart: As a matter of fact, you made the statement, Mr. Minister, that we are one-third whereas most countries are two-thirds.

Hon. Mr. Drury: I will try to get you some precise numbers.

Senator Carter: The precise numbers are not that important. It is still not satisfactory.

Hon. Mr. Drury: You are talking about one-third and you are asking me to confirm one-third.

Senator Carter: Whether it is one-third or one-quarter or even one-half does not matter. It is still not satisfactory. What I am interested in is what steps are being taken. You mentioned the make-or-buy policy, but it is not clear from your dialogue with Senator Grosart whether this make-or-buy policy is additional money going to the sector or whether it is money being transferred from the intramural to the industrial sector. If you say that the distribution

with respect to government and universities is comparable to these other competing countries and is satisfactory, but that the discrepancy exists with respect to the industrial sector, then surely more funds have to be made available to that sector. There must be additional funds over and above what is there now. Surely you have to do one of two things: either reduce the dollars from the universities and government and transfer them to the industrial sector; or provide new money, extra money. What I want to know is just what are you doing.

Senator Grosart: Perhaps I could refresh the minister's memory on the one-third. In a speech he made to the Purchasing Management Association of Canada on January 21, 1975, he made this statement:

Roughly one-third of all research and development performed in Canada is done in industry as compared to about two-thirds for most other industrialized countries. I do not expect the minister to remember everything he has said, but that was the statement to which Senator Carter was referring.

Hon. Mr. Drury: Yes, and I think perhaps that will enable me to make the point I was just going to make with Senator Carter. That one-third to two-third ratio is made up of two sources of resources: one is the corporate source—their own money which they are spending; the other is the government.

I do not accept that all the money spent in industry on research and development should be coming from the taxpayer. If the progress that one is seeking is not being made, it is not entirely due to a lack of funding by the federal government.

Admittedly, we have not achieved the success which would raise our comparability to what we think are desirable levels, but we have in operation the make-or-buy policy, and, as a matter of policy in relation to this, all new money for mission-oriented, as distinct from curiosity-oriented research, which can be, is contracted out. It is only where it is manifestly impossible—either by reason of time frames and the non-existence of institutions to do it or by reason of the fact that it would be economically ridiculous to contract out—it is only in these cases that new projects, new money, are not contracted out.

Senator Carter: Have you analysed the problem to find out whether this imbalance in the industrial sector is due to our branch plants situation; and, if so, if it is due to government strategy so far as we have pursued it over the years, surely the government has some responsibility to encourage business to create more capacity and to correct this imbalance? I do not think you can expect under our branch-plant environment, or under the type of economy we have, that the private sector can do this all by itself without some encouragement from government. There must be some specific problem that needs a specific plan of action.

Hon. Mr. Drury: The fact is that Canada has 3,000 miles of undefended border with the United States, and, because of the intimate relationship which exists between these two industrial communities, we have both easy and, relatively speaking, cheap access to the largest pool of technology in the world. This means that Canadians, whether they be owners or managers of enterprises, have cheaper access to new technology than most of the other OECD countries. Faced with a choice of buying technology cheaply, or trying to generate it themselves at higher cost, they

have chosen the cheaper route. In the short run there is no question but that it is cheaper.

Senator Carter: But we have only one-third the capacity we should have.

Hon. Mr. Drury: One would expect them to do this. It produces a situation in which, as you point out, we have only one-third of the capacity that our competitors have, but I suggest that the reason they have it is that they need it. It is cheaper for them to establish the capacity and generate their own than to acquire it by purchase. This means that the need—in an economic sense, anyhow—for this kind of capacity in Canada is likely to be less for us than for any other of the ten.

Senator Grosart: In spite of our deficit in international trading in technology-based exports? In spite of that, are you saying our need is less?

Hon. Mr. Drury: Less than any other of the ten, yes.

Senator Grosart: Why? Because we can sell primary resources?

Hon. Mr. Drury: The disadvantages of this are really twofold. In the first place, we are extremely vulnerable to being cut off from it as a consequence of political decisions. If our relationship with the United States were to deteriorate we might find ourselves arbitrarily cut off from cheapness in the first place, and accessibility, which we now enjoy in greater measure than the other OECD countries, in the second place.

This vulnerability is something which is undesirable. In order to make ourselves invulnerable we should be prepared to make an investment in invulnerability, which means paying a greater cost. This is one of the reasons, in the interests of reduced vulnerability, why we want to see the proportion rise from its present rate of one-third, to parity, or something close to it, with the other countries, in order to reduce our vulnerability.

Secondly, if we have this capacity ourselves, it means not only that we are less vulnerable to being cut off from technological information, but that we have a much greater degree of independence in manufacturing, and also in marketing. This is the reason why we want to achieve a higher degree of comparability and a higher degree of capacity within Canadian plants and within Canadian manufacturing, while at the same time recognizing that to go to the same level as the United States or Germany would probably be uneconomic. We would therefore expect to be rather lower down in the list that we would be if we had parity with the top countries. Do I make myself clear?

Senator Carter: Yes. I could rebut it, but I have to pass. Somebody else needs a chance.

The Chairman: I think Senator Belisle had a brief question.

Senator Bélisle: Mr. Chairman, would you permit me a very brief supplementary?

The Chairman: Certainly.

Senator Bélisle: Mr. Minister, in the light of the information we received during your dialogue with Senator Grosart and with Senator Carter, arising from the answers you gave to Senator Carter particularly, my question is this: When you said you had failed, did you say that with humility in mind, or did you say it in order to protect the

former minister? Did they have any plan? Were they ignored if they did?

Hon. Mr. Drury: First of all, if you are trying to quote me, I did not say we had failed. I said that we feel we have achieved less success than we had hoped for. Next, the fellow you refer to, when you ask me if I am protecting somebody, is called Drury.

As I pointed out at the beginning, the last time I was here the talk was about incentives to achieve, in relation to a specific project, the purpose I have been discussing with Senator Carter. That, fortunately, turned out all right; but, as I say, we have not achieved the success we hoped for. There was a temporary increase in expenditure, which means an increase in innovative capacity, within the Canadian manufacturing industry following the initiation of these programs. That fell off, and is now recovering slightly. Recognizing this, we are now carrying out, and have been carrying out for some time, an in-depth review of all of these incentive programs, most of which are, of course, on the part of the Minister of Industry, Trade and Commerce.

Senator Bélisle: Thank you, Mr. Minister. Mr. Chairman, you were so kind as to permit me a supplementary, and I will not ask any more questions, although I could.

The Chairman: I am sure you will have the opportunity later on. Senator Lang.

Senator Lang: I will skip my preamble and go right to the specifics.

Mr. Minister, you referred previously to the Arrow program, the satellite program, and the CANDU program, which I presume were really scientific thrusts designed to meet certain specific Canadian needs. What specific Canadian needs do you now see as being foremost, that are amenable to a scientific solution?

Hon. Mr. Drury: Generally speaking, the larger one-word ones are communications, including the satellite aspect of that area, and energy.

Senator Lang: I notice in your brief, in Appendix C, you give case histories of major science policy initiatives, and under that heading we have an oceans policy. Is this the only major science policy initiative referred to that is under active pursuit at the moment?

Hon. Mr. Drury: Well, the oceans policy has been evolving. Canada has a longer coastline than almost any other country in the world, and consequently more ocean contiguous to it. Consequently, also, it has more resources to exploit, in the best sense of the word, relatively speaking, than other countries. We, as Canadians, have been, if I may so put it, rather absentminded about what the oceans could mean to us. This involves almost every field of our economic activity in the air above the oceans, on the surface itself—principally for transportation, but also for defence—the body of water itself, with its resources both of energy and the biosphere that it has or could have, and finally, the bed of the ocean and all that lies under it. So, in a sense, it is a whole new world, and the genesis of the ocean policy was to indicate the interest of the government on behalf of Canadians in this new world. This new interest called for action on almost every single front in the government. The Department of External Affairs is leading the program or operation to secure the assent of other countries to our controlling and administering something more than the three miles that hitherto we had

conventionally controlled and administered. To look at the exploitation of the resources of the body of the water within that area, which hitherto not much had been done about, the lead here is taken by the Department of Environment. In the business of transportation and the use of the surface, this principally concerns the Coast Guard under the Ministry of Transport, but also the development and the use of different kinds of vessels in this hitherto, so far as Canada is concerned, virtually unused environment. Finally, there is the exploration and subsequent exploitation of the sea bed, that portion of the earth's crust lying underneath the surface of the sea, and here the lead has so far been taken by the Department of Energy, Mines and Resources. So that what in fact started out by being described as the "oceans policy" in fact has become a new element of policy for the Department of Energy, Mines and Resources. It has become a new element of policy and preoccupation for the Department of Environment, and has become a new element and preoccupation for the Ministry of Transport.

Senator Lang: Is there any co-ordination among those four departments you have referred to where this program is concerned?

Hon. Mr. Drury: Yes, there is co-ordination, but this co-ordination is provided largely by the lead department in a particular sphere. When it comes to the establishment of jurisdiction and control, then it is the Department of External Affairs which takes the lead and, consequently, that is the department responsible for co-ordination. So far as the underwater part of the ocean is concerned, its exploration and exploitation, there the administration and control would come under the Department of Energy, Mines and Resources, and the co-ordination of activities with other government departments who may be involved lies with them. An overview of this is continuing to be taken by the Ministry of Science and Technology, but as this becomes a part of our operational environment, the special initiating role that MOSST had will tend to disappear and dissolve.

Senator Lang: You mentioned energy as being a prime problem for Canadians, and I do not think that anybody will disagree with you on that. What, if any, activity is going on in MOSST with respect to the development of a scientific approach to our energy problem?

Hon. Mr. Drury: What is currently being done is the development of a comprehensive program which is having its genesis in the Department of Energy, Mines and Resources. Here is where the greatest body of knowledge in this particular field lies and here is where you find the greatest awareness of the problems.

Senator Lang: Are they carrying out any specific mission-oriented research in energy matters?

Hon. Mr. Drury: They have established an office of energy research and development which is still relatively small. This office has put together an analysis of potential and possibilities, and has also put together a program of research to be carried out partly by the department, or elements of the department, partly by other government agencies, partly by universities and partly by industry. This program of research will be based on targets of, if I can put it this way, three levels of operation in specific fields. The first will be either production of energy, or increased production; the second is research and development; and finally, in some fields, the possibility of merely

having a level of awareness sufficient to enable us to realize the potential of a particular field, and by keeping track of what other people are doing to know whether it is now or in the short-term future appropriate for us to go from just the awareness to either development or new production. If one looks at the various fields, one finds in relation to hydro electric power that there are relatively few areas for technical research available, except perhaps in the tidal field. Consequently there will not be, other than geological and economic exploration, much done in the field of tidal power.

The Chairman: But, Mr. Minister, you are always referring to the future. By this do you imply that we have not up to now done any research in the field of energy?

Hon. Mr. Drury: Not at all. Do you want me to deal with what research we have done?

The Chairman: No, but the implication of your statement meant that you were always speaking about the future—"We will do this and we will do that." I wanted you to state clearly that we have done some research in the past in this field. At least, I hope we have.

Hon. Mr. Drury: Yes. I regret to say I had assumed honourable senators were fully aware of what we had done and what we have not done. I am trying to respond to Senator Lang to indicate how in the energy field the research and development effort was being put together, and what will be done henceforth.

Senator Lang: You mentioned potential tidal power. What other sources of energy are being studied?

Hon. Mr. Drury: By location?

Senator Lang: By type.

Hon. Mr. Drury: I was trying to tell you what is happening in hydro. We have nuclear energy, which can be divided, or subdivided again, into fissionable and fusion, fission being the technique which is pretty highly developed now in the CANDU reactor, the CANDU technique. There are still possibilities of further development, but this is not as fundamental a potential as fusion. Fusion, which has the very marked advantage of not having a noxious by-product after the extractable portion of the energy has been removed has great potential.

Senator Lang: Surely we would buy that rather than trying to develop it ourselves, would we not? That is a pretty expensive field.

Hon. Mr. Drury: There are a number of aspects of it which are very expensive indeed. MOSST commissioned a rather extensive study on fusion research and development. As a consequence of this we have come to the conclusion that in some aspects the techniques for containment of this energy before it can be translated into use require huge and very expensive installations. If we get into this area at all, it must be on a joint basis with other countries. The current possibilities for initiation of the operation of fusion as an energy source are laser beams. In laser development we have already had some quite remarkable successes, so in the field of lasers we are going to proceed beyond merely awareness, which we will do in relation to magnetic containment, up to development; so there is a program for laser development.

Senator Bélisle: Is there any solar energy research?

Hon. Mr. Drury: I was just coming to that. There is quite an extensive program.

Senator Lang: Under what department does the laser program come?

Hon. Mr. Drury: The laser field comes under the National Research Council. They will be doing some work on this. As lead department, they will commission some of it to be done in universities, and hopefully they will commission some of it to be done in manufacturing industry. I speak of the spectacular progress we have been able to make in lasers. This was mostly as a consequence of the efforts of the Defence Research Board laboratory in Valcartier. It is really following on this, and I would just indicate to the senator that it is a case of follow-on, not something brand new that we know nothing about.

A significant element in the decision whether we should go into any field in a larger way is the measure of success that we have had in a particular field in the past. You use your performance to date as an indicator of the likelihood or probability of success in the future.

With respect to solar energy, Canada is in a climatic zone where the efficiency of the sun in delivering energy to us directly is less than it is in countries in the equatorial belt. Therefore, there are fewer advantages, fewer attractions, to us, than to countries in the equatorial belt through large-scale use of solar energy. We have concluded generally that there is a possibility for small individual residential uses of solar energy, but that the conversion of solar energy into large quantities of electrical power by utilities would not, in the present state of the art at any rate, be economical or attractive for us. Therefore, what we are doing is pushing development of small solar energy units for heating purposes, for residential accommodation, and I suppose in some cases for commercial or industrial accommodation.

Senator Lang: Who is pushing them where, Mr. Minister?

Hon. Mr. Drury: I am not too familiar with the details on this. I will ask Dr. LeClair to answer this.

Dr. M. J. LeClair, Secretary, Ministry of State for Science and Technology: MOSST commissioned a study on this by the Brace Research Laboratory of McGill. That report is now in. NRC is the lead department in solar energy research.

Senator Lang: I suppose the next thing would be oil and gas. We have had a pretty varied experience with our prognosticators over the past five years with reserves of energy in this form. Latterly we have been taken up short by the figures published by the National Energy Board as to the sufficiency of Canadian supplies and their duration. I think the public generally is wondering whether they are getting a snow job from the oil companies. Can you give us any indication of the present government position on our exploitation of oil and gas, and the expectancy of our reserves in terms of years?

Hon. Mr. Drury: Mr. Chairman, I would suggest that Mr. Gillespie could better provide the answer to that question. Before I would attempt to answer Senator Lang, I would turn to Mr. Gillespie and be briefed by him. But that would be second-hand. I do not know the details of our position in relation to petroleum resources. In any event, I would have great hesitation in putting a number of years on it, without some pretty heavy qualifications.

Senator Lang: Can you say anything about coal?

Hon. Mr. Drury: Again, in the field of energy, coal is an area in which we have substantial deposits. Without beginning to do all of the classification and subdivision, let me say that we will be doing a program looking to the possibilities—not actually doing it but simply looking at the possibilities—of doing an economic classification of our coal deposits, given the fact that one of the serious barriers to the greater use of coal in this country, particularly with respect to strip-mined or surface-mined coal, is the transportation economics. I am sure the senator is well aware that the long-distance transportation of gas is much easier and far less costly. It is much more economical to transport energy in the form of gas than as a solid or in the form of coal.

Senator Lang: Is there any research presently underway with respect to long-distance transmission of electrical power?

Hon. Mr. Drury: Electrical power?

Senator Lang: For example, if it was found that it was most economical to build a thermal plant at a coal site and transport the energy in the form of electricity.

Hon. Mr. Drury: Extensive work is being done in that line. That is not something new. That work will be continued. That work involves the general problems of transmission over long distances of electrical power, particularly at high voltages. There is a joint laboratory between the federal government, the responsibility for which is in the National Research Council, and Hydro Quebec, near Bécancour.

Senator Lang: What concerns me in this line of questioning, Mr. Minister, is that in both the oceans policy and the energy policy we seem to find all of the problems fractioned off into various government agencies or departments without any general overall policy direction, other than to take inventory of our present situation. I am concerned that we could be taking inventory from now until the year 2000 without getting any initiative into the system. Is that a concern to you, and, if so, do you think we can overcome that problem through an agency such as MOSST or would it be in some other way?

Hon. Mr. Drury: You say you are worried about the initiative, and that one really should not rely on the Department of Energy, Mines and Resources to show the initiative or to address themselves to these problems. I do not think that is so. I have just indicated that the Department of Energy, Mines and Resources has put together a comprehensive research and development program covering all of these aspects of the energy field.

The Chairman: That is not what your document says. Your document says that this is still under consideration by cabinet. There is no program yet.

Hon. Mr. Drury: Well, in fact I am taking advantage of a very short timeframe here. At the time it was written it was true. Since that time two weeks have passed, and so rapid is the initiative that what was hitherto only a dream is now a decision.

The Chairman: After two years.

Senator Carter: Would Senator Lang include methanol as a source of fuel on the energy list?

Senator Lang: That would be a pretty small factor.

Senator Carter: Well, we have tremendous possibilities for that in Canada, you know.

Hon. Mr. Drury: Generally speaking, in the biomass field here, because we cannot cover all possibilities—we just have not the resources, particularly at a time when the public of Canada is asking for restraint, we have to make choices. We choose those fields which have the greatest potential.

Senator Grosart: Who chooses?

Hon. Mr. Drury: Well, I suppose one might say the choice is made by the cabinet. We choose between those fields which we will put the resources into or concentrate on and those which we hope others will take care of. At the moment the biomass and all of its energy products is not a field which seems to offer the attractions of short-run benefits, and there are a number of other countries more advanced than we are in this field. Therefore, it would be our purpose to make sure we maintain a working knowledge of what they are doing and discovering. That is what I call a level of awareness.

Senator Lang: The research team in the Department of Energy, Mines and Resources is concerned with final policy. It is a decision, I presume, by cabinet. Is that an in-house research team or does that involve the private sector at all?

Hon. Mr. Drury: It is not a research team. Like MOSST, it is in a sense, but in a larger way, a small planning group in the energy field. The actual research will be carried out, not by that department but by others. In some cases, indeed in a great many cases, it will be carried out not even by government departments, but by either research teams in universities or research teams in industry.

What we have is a complete plan of work to be done in the energy field, and of who is going to do it. All those who are going to do it are spelled out. The purpose of this is the kind of planning to bar accidents that Senator Grosart feels we are the victim of. There has been comprehensive planning here, and a scheme has been developed to make sure that no bets are overlooked, and that there is no well or badly inspired, independent and, if I may use that term, unco-ordinated action.

With regard to whose idea it was and who pushed it, you are trying to encourage me to say that the idea was MOSST's, and that it was MOSST that was pushing it; but I will decline that invitation. I do not think there are many yards to be gained by asserting either jurisdiction or originality of thought.

Senator Lang: May I ask one final question? After energy, Mr. Minister, in your opinion what is the next most urgent problem facing Canadians to which a scientific effort could be devoted?

Hon. Mr. Drury: Your first question, which I answered quite quickly, was, "Which are the most urgent problems which have a large scientific and technological input?" The answer I gave did not mean that in my view the government's most urgent problems were the two I mentioned, but rather that they were the ones with a big scientific and technological input.

The second one I mentioned was communications, and this will always be a problem for Canada. As a very large territory with a relatively sparse population we have com-

munications problems which, in some cases, are unique to Canada, and which in other cases are present in a much greater degree or which are more significant than they would be in other countries. Insofar as the problems are concerned that are unique to Canada, there is not much use in hoping that somebody else will do the work and solve the problems for us. In this field, therefore, we have to address ourselves to the problem independently, and not rely on anyone else. Where things which are terribly significant to us are a problem, but not to others, we will probably have to do our own work, too; but there are certain areas in the communications fields which are problems that are common to ourselves and to others. We cannot do everything simultaneously, and we will have to rely on others to do the work and hope that by making contributions in parallel or similar fields we will be able to benefit from their increasing knowledge and the solutions they find.

Senator Lang: Undoubtedly the mails are our worst problem in communications.

Hon. Mr. Drury: This is one problem the solution to which does lend itself to technology. Part of the problem, however, is in the introduction of this new technology.

Senator Godfrey: I want to clear up one small confusion. You are talking earlier about our doing one-third of the research in the industrial sector, and our competitors doing two-thirds.

Hon. Mr. Drury: Not quite. We only did one-third as much as they did.

Senator Godfrey: Yes. It is one-third as much.

Hon. Mr. Drury: Yes. The two-thirds is probably the ceiling at which we should aim, given our particular case. It would be stupid, you know, for us to go for one hundred percent.

Senator Grosart: That was not the statement that the minister made. He said that roughly one-third of all research and development performed in Canada is done in industry, as compared to about two-thirds. It is not a question of a third of what somebody else is doing.

Senator Godfrey: Compared to two-thirds. My mathematics would make that one-half. Fifty per cent, not one-third. I wrote down, "One third of the capacity our competitors have." If our competitors have two-thirds and we have one-third, my mathematics gives me 50 per cent of theirs.

The Chairman: What the minister said is that in Canada Canadian industry was accounting for one-third of our total expenditure for research and development, whereas in most other countries industry accounts for two-thirds of the total effort.

Senator Godfrey: That is right. Then he went on to say that therefore we have one-third of the capacity of our competitors. When I went to school that meant one-half of the capacity. I am trying to get that straight. Really, in comparison to our competitors, we have one-half, and not one-third.

Senator Grosart: That is not so.

Senator Godfrey: My mathematics are lousy, I know.

Senator Grosart: Yes, they are.

Senator Godfrey: I am still confused.

Senator Grosart: The question is, of the total funding of science and technology, what percentage is performed in industry as against what percentage is performed elsewhere, most of it in-house.

Senator Godfrey: But we are one-third, and our competitors in other countries are two-thirds.

The Chairman: Yes.

Senator Grosart: No. This is a question of performance.

Senator Godfrey: Yes, performance.

The Chairman: Well, do you want to ask further questions, Senator Grosart? I suppose we should plan to adjourn around a quarter to one.

Senator Grosart: I have just one question. When Mr. Gillespie was Minister of Industry, Trade and Commerce, he made this statement:

The traditional policy of having government facilities perform by far the largest share of R&D work for government has served its purpose but cannot meet Canada's future needs.

Is this still the policy of the government, if in fact the traditional policy of having government facilities perform by far the largest share of R&D work for government cannot meet Canada's future needs? That was said in 1972. Do we still believe that?

Hon. Mr. Drury: Yes.

Senator Grosart: Good. I am glad to hear it. We have not done anything about it, but perhaps we will in the years ahead.

Senator Carter: I was only half way through my list when my time ran out, Mr. Chairman.

The Chairman: I have not even begun mine.

Senator Carter: Then I will pass in deference to you.

The Chairman: I do not intend to ask questions today, so go ahead.

Senator Carter: What I want to get at is, do we know what is going on all over the country? Have we compiled an inventory of scientific projects that are in progress? Do we know what is going on in government? Do we know what is being done in the various universities? Do we know what is being done in the private sector? Do we have any means of finding out whether there is any overlapping, or whether there is any way of co-ordinating the effort that is being made?

Hon. Mr. Drury: To make the statement, "We know", would be challengeable, I think, on the ground of the question, "In what detail?" We have tried to compile an inventory of the research work being done within the federal government, and I take it you are talking about research work. This is a continuously changing list, and the more detailed it becomes, the more frequent and rampant the changes are. To keep such an inventory would require a very substantial staff.

Senator Carter: Are we devising a means of finding out whether all of these are useful, whether some should be discontinued or whether some are overlapping what is

being done in other places in industry or in universities or even in other government departments? Have we any mechanism to review that and to do something about it?

Hon. Mr. Drury: We are in the process of trying to establish what I would call a data bank in the branch of the National Library run by the National Research Council. Here is kept on a very large computer all, or as much as we could get, of the current research efforts and results in Canada. The government and its agencies have easy access to this computer. Currently the National Research Council is trying to work out economic techniques to give universal access to this information with a view to avoiding duplication, with a view to avoiding, in a sense, re-inventing the wheel. So far we have not managed to devise an economic, widespread access to it. All we have so far is government access to it. Any researcher in any field in the government can now easily and readily call on this data bank to discover what is the existing state of the art, and consequently not do or re-do unnecessary work.

Senator Carter: But supposing the data bank shows that there is overlapping, what do you do about that? Or can you do something about it, the way you are set up now?

Hon. Mr. Drury: It depends somewhat on the purpose of the particular research being done. There is some research engaged in as a teaching tool—as a means of teaching a man to be a researcher. In this case duplication is not a disadvantage; in fact, it may have a great advantage. In the case of private industry, they are the ones who make the choices on a competitive basis; they decide what research they want to do and what area they want to work in. So there may well be two companies in a similar line of activity who will be doing the same research work. This is what a competitive system produces, and I do not think this is the kind of thing that we should try to cut out. To the extent that we can do so, we would like each of them to know what the other has been able to accomplish so that there will not be wasted effort, but to stop them engaging in this activity does not seem to be desirable.

Senator Carter: How would you go about stopping them? That is what I am getting at.

Hon. Mr. Drury: Well, we don't.

Senator Carter: You can't.

Hon. Mr. Drury: I don't think it is desirable.

Senator Carter: That is pretty dogmatic. Surely there must be something going on that is useless or that has outlived its usefulness. Are you saying that it is not desirable to stop that?

Hon. Mr. Drury: What has outlived its usefulness or is, in effect, useless, depends again on where it is being done. If it is being done in private industry, it is of little use for the government to say, "You fellows don't know how to run your business. We in Ottawa know better."

Senator Grosart: You do that all the time anyway.

Hon. Mr. Drury: It does not really get much credence.

Senator Grosart: I want to come back to the central point, and perhaps I can illustrate it by reading a sentence from paragraph 22 on page 7 of the presentation that MOSST made to the committee. It says:

a science budget in the conventional sense (i.e. as a basis for resource allocation) cannot reasonably be

accommodated in the existing structure and procedure of the Government;

The opposite was very central in our recommendation. I think there has obviously been a misunderstanding of our recommendation, because it seems to me that this presentation says that you have already accommodated it within the existing structure. Then you say in the next paragraph, paragraph 23:

The Government can however, through the Ministry of State for Science and Technology, ensure that plans and budgets for scientific activities are screened by competent analysts...

And that is MOSST, and that advice is introduced. Then you say again at paragraph 42 on page 13:

The separate preparation of data in connection with science expenditure proposals was initiated with the Treasury Board...

And then you say in paragraph 44, at the bottom of the same page:

Thus, science budgetary information was, for the first time, made available with Main Estimates data.

Then in paragraph 46 on page 14 you say this:

... TBS has advised departments, who have not done so, to consult MOSST before putting forward submissions.

All this would seem to say that you have a visible science budget in advance of the authorization of expenditures by Treasury Board. But in paragraph 20 on page 6 you state:

The Senate Committee felt strongly that MOSST's role as described in the Order in Council came... "within the framework of the coordination model", and lacked the authority needed for an effective central agency. The Committee recommended that the Ministry's role be within the framework of the "concerted action" model and specifically that the Ministry's terms of reference be modified to give it budgetary authority in relation to science.

And then in the next paragraph you use the word "authority" again.

What I want to suggest to you is that we never suggested anything of the kind. We never suggested budgetary authority. What we said was that MOSST should assess and review the science budget. What I would like to ask you is this: Does this mean there is a visible science budget, because you say that MOSST reviews them, reviews the proposals and then advises Treasury Board. So I am asking if there is now a visible science budget available to MOSST in advance of the authorization to spend public funds on scientific activities. Perhaps that could be answered yes or no.

Hon. Mr. Drury: I will answer it "yes or no". What do you understand by "budget"? What is a budget?

Senator Grosart: As you know much better than I do, Mr. Minister, a budget is a series of proposals for spending, for which authorization by Parliament is asked. That is the budget. The main estimates take in every single request to Parliament for authorization to spend money. That is what a budget is. I am not taking it out separately and saying, "This is a science budget." It is a budget for science expenditure. What I am suggesting is that you say here clearly that you have this, yet somewhere else you say you

cannot have a visible budget in advance. A budget is a list, a compilation of all the requests for authorization by Parliament to spend. Do you have all of these before you, as you suggest here? If you have them, then I say you have a visible science budget in advance of authorization.

Hon. Mr. Drury: Then the answer is that we have a visible science budget. In popular jargon, the budget of Canada is presented by the Minister of Finance, who makes no reference whatsoever to a thing known as the blue book. You say the budget is the blue book.

Senator Grosart: "Budget" is used in many senses; let us not get down to just one. I am asking if you have a visible compilation. Let us leave out the word "budget". Do you have a visible compilation of the requests for authorization by Parliament to spend this year \$1.4 billion or \$1.5 billion on science activities throughout the departments and elsewhere? Does MOSST have that before Treasury Board authorizes it?

Hon. Mr. Drury: The answer to that is yes.

Senator Grosart: Then why do you say that a science budget in the conventional sense—which you describe, you describe it exactly, and this is why I come back to the silly semantics—is a basis for resource allocation? What else can it be? If you are looking at it, you can only be looking at it as a basis for resource allocation in science. That must be the main reason you are looking at it. Therefore, you have a budget, according to your own description, in the conventional sense. Yet we still have these silly semantics. That is the point I am making.

When you say this committee suggested MOSST have a role for budgetary authorizations, I say we did not; we did not say that MOSST should "authorize" it. What we did say—and this is a minor point—was that there should be an intermediate body, a council of ministers. The reason we said that was to ease this situation in which a departmental minister might say, "I am not going to be told by one other minister what I should do in this particular area of expenditure."

We then suggested that there might be a council of ministers, just the same as you have a council of ministers in the Treasury Board and in planning, who would obviously be the main science spenders, who would then get together and say, "Yes, this makes sense. We will look at MOSST's suggestions about it. We will then carry it into Cabinet"—not to the Treasury Board Secretariat but to Treasury Board, and through Treasury Board to the Cabinet. That is what we suggested, but the suggestion all through your document is that you have rejected this, you have rejected a visible science budget. I am glad to say that, in my terms at least, you have not. I say "in my terms" in case anyone wants to quarrel with that.

Secondly, I say this statement just does not make sense, that "a science budget... cannot reasonably be accommodated in the existing structure". It has already been accommodated.

Hon. Mr. Drury: If you are suggesting that some group of ministers, not including the Minister of Agriculture...

Senator Grosart: No; I said the science spenders—and he is a big one.

Hon. Mr. Drury:—should say to the Minister of Agriculture, "You are spending too much or you are not spending enough on science and technology, in carrying out your mandate," and have the power to impose on him, more or less, I would disagree.

Senator Grosart: I would too, because I am not saying that at all.

Hon. Mr. Drury: Here we have a so-called science budget for the whole of the government, and a group of ministers will look at this and say whether or not it is proper, and where it is not proper, modify it, and then impose that?

The Chairman: What is Treasury Board doing?

Hon. Mr. Drury: What do you do with it?

Senator Grosart: You carry it to Cabinet and accept Cabinet's decision. So far as I know, no one imposes on Cabinet. The Prime Minister may, once in a while, I suppose, but ministers do not impose on each other; they give each other advice. The whole purpose of the suggestion is not to say, "You are spending too much", or, "You are not spending enough." It is to ask, "Are you spending it in the right places, in terms of the allocation of all our money for science activities? Are too many departments using the same university?" We asked the departments, "When you decide to fund X university with Y dollars do you know at that time what any other department is doing?", and the answer in every case was, "No." That is the kind of thing we are getting at. I will not argue whether there should be that council of ministers; that does not matter. If MOSST does the assessment and review and carries that into Cabinet, that is all we are asking.

Hon. Mr. Drury: The answer to that is basically yes; but rather than carry it into cabinet as a first step, we carry it to the minister concerned.

Senator Grosart: And to Treasury Board, which must make the overall decision on the proper or improper allocation of all our resources to all departments, and therefore to all activities of the government. That, surely is the job of Treasury Board and of Cabinet, to ensure that the allocation of public funds is to the right places. That is all we are suggesting, yet we keep getting these silly semantics.

The Chairman: On this unanimous vote, we will adjourn for the time being. I thank the minister for being with us this morning. I understand he can be available on two other occasions, if necessary, before the Christmas recess. I have not discussed this with my colleagues, but we will discuss it after we adjourn.

Senator Grosart: I hope the minister will come as often as he can.

The Chairman: I would certainly like to see him again.
The committee adjourned.

APPENDIX "1"

September 17, 1975.

Dr. Maurice LeClair,
Secretary for the Ministry,
Ministry of State for Science
and Technology,
Martel Building, 270 Albert St.,
OTTAWA, K1A 1A1.

Dear Dr. LeClair:

Re: Senate Committee's forthcoming enquiry
into science policy, beginning November
1975.

The Senate Special Committee on Science Policy presented a report to the Senate on July 10, 1975. As you will see from the copy of this document which I have enclosed herewith, the Committee has been given a broad mandate and is "authorized to consider and report on Canadian Government and other expenditures on scientific activities and matters related thereto."

When we initiated our first inquiry in 1968, we submitted a detailed questionnaire to all federal government departments and agencies (see Volume 1, pp. 289-297). This questionnaire was designed with the hope that the data requested would help promote a better understanding of how science policy is formulated and implemented within the federal government. The response contained in the briefs we received included the most detailed information yet gathered in Canada regarding the selection, implementation and results of specific R & D policies. We hope that this information, as it appeared in the Committee's proceedings, has been as valuable to NOSST as it has been to us and to others.

In the process of carrying out our new mandate, we are asking all federal government departments and agencies to up-date the information contained in their first response. This exercise will provide a basis of comparison enabling us to detect the most interesting developments which have occurred during the last seven years. We do not intend, during our second inquiry, to hear all government departments and agencies and to publish all their briefs but we will be glad to make them available to you s. as to enable your Ministry to make its own assessment of recent trends.

Although our new mandate is very broad, our report to the Senate clearly indicates three specific areas which have a special interest to us.

1. With regard to futures studies, you will receive shortly another letter and a questionnaire. In your response, we would like you to indicate not only your own activities in this area but also the role that the Ministry plays or intends to play in the assessment and co-ordination of futures research carried out by other government departments and agencies.

2. The Committee, in its report on science policy, has made more than 80 specific recommendations and many other suggestions. In its role as the main central agency for science policy, your Ministry has undoubtedly been involved in the government reaction and response to these proposals. We would like to know what are those which have been rejected and why, and what are those which have been accepted and how they have been implemented.

3. More specifically, the Committee proposed in Chapter 19, Volume 3 of its report the adoption by the Canadian Government of the basic features of the concerted action model for the organization of its scientific activities. We would like to know what has been the Ministry's reaction to that proposal.

In Chapter 20, the Committee made a number of recommendations and suggestions regarding the role of MOSST; they were designed to implement the concerted action model. We would like to know what happened to these proposals.

In a series of press releases issued by the Honourable Jeanne Sauvé on February 28, 1974 and to which reference is made in our report to the Senate dated July 10, 1975, the then Minister of State for Science and Technology announced that MOSST was taking concrete measures including the preparation of a science budget display, leading to the adoption of the concerted action model. We are interested to know how these measures have been implemented.

To appreciate the impact that these measures have had, we would like to get from you a detailed description of a few case histories of science policy making. These case histories should include the "make-or-buy" policy, technology strategy, energy, ocean resources and food but you may refer to others as well if you believe that they are also illuminating. We hope that your description of these R & D policies and programs will make the decision-making model as visible as possible and cover in each case the initial objectives, goals and commitments, the means used for implementing them, including specific projects, financial aspects, organizational and administrative procedures, and the techniques applied for measuring results or outputs.

Finally, we would like to get a description of the Ministry since it was created; it should cover the evolution of its main activities, of its administrative structure and its professional staff.

In response to this letter, the Ministry may add, of course, any advice, perspective or information that could be useful to us. We hope, however, that the Ministry's brief will be sent to us as early as possible in November, because we expect to begin our hearings with this brief in the middle of that month.

You must realize that MOSST has a very special interest for us. When we began our hearings there was no ministry responsible for science policy. In other words, as many people told us, there was a vacuum at the top. We know that MOSST's role as the main focus of the government central machinery is not easy but we are equally conscious of the fact that if the Ministry does not fully fulfill its broad mission government involvement in science and technol-

ology will likely be quite ineffective. Our main purpose in resuming our hearings is to try to help your Ministry and, for this reason, we hope that it will fully co-operate with us.

Yours sincerely,

Maurice Lamontagne

APPENDIX "2"

OTTAWA, Ontario
September 17, 1975

Mr. J. Shepherd
Executive Director
Science Council of Canada
150 Kent Street
OTTAWA, Ontario
K1P 5P4

Dear Mr. Shepherd:

I was very pleased to have the opportunity of talking with you and I would like to thank you, on behalf of the Committee, for your offer of support and cooperation as we proceed to assess recent developments in Canadian science policy. I see the activities of the Council and the Committee as being complementary and serving a common purpose: a more efficient government involvement in science, technology and innovation.

Our Committee presented a report to the Senate on July 10, 1975. As you will see from a copy of this document which I have attached herewith, the Committee has received a broad mandate; the Committee is "authorized to consider and report on Canadian government and other expenditures on scientific activities and matters related thereto".

Although these terms of reference could cover almost anything pertaining to science policy, our report makes it clear that we are not intending to start a general enquiry as we did in 1968. We merely want, now, to look at the main trends which have appeared within the past few years and the

most likely developments that could be anticipated in the near future. For that purpose, we are asking all government departments and agencies to update the information contained in the brief they prepared in response to the detailed questionnaire that we circulated in 1968. The text of this questionnaire has been reproduced in Annex B of Volume 1 of our report on science policy.

We are therefore asking the Science Council to respond to that questionnaire to the extent that it is relevant to its activities.

We are also requesting all departments and agencies to tell us how they reacted to the recommendations and suggestions specifically made to them in our report on science policy. We would like to know if they rejected these proposals and, if so, why; and, if they have accepted them, how they have implemented them. We are asking the Council to respond to this second specific request.

In the process of responding to the two requests just mentioned, we hope that the Council will also indicate to us how it is presently perceiving its role, and within the terms of its broad mandate, what areas and issues of science policy it intends to emphasize in the next few years.

In view of the importance of the Council as an essential part of the government's central machinery for the formulation of science policy, we hope that it will feel completely free, if it so wishes, to react to all the recommendations and suggestions in Volume 2 and 3 of our report, and to give us any additional advice, perception and information that may be useful.

We hope to receive the Council's brief as early as possible in November because we expect to begin our hearings in the middle of that month.

I want to repeat again that I see the Council and our Committee as fulfilling the same basic advisory role. It is obvious that in exercising that role we may occasionally develop diverging views and put the emphasis on different priorities and issues. However, we should always seek to reach

a consensus in a spirit of partnership. Otherwise, our respective activities will be competitive rather than complementary and we will not reach our main goal. It is in this spirit of partnership that I invite the Council to cooperate with us in our new endeavour.

Yours sincerely,

Maurice Lamontagne

Encl.

APPENDIX "3"

1st. letter to all gov. depts. and agencies

September 23, 1975

Re: Science Policy

The Senate Special Committee on Science Policy presented a report to the Senate on July 10, 1975. As you will see in the copy of that document which I have attached herewith, the Committee has received a new broad mandate; the Committee is "authorized to consider and report on Canadian government and other expenditures on scientific activities and matters related thereto".

Although these terms of reference could cover almost anything pertaining to science policy, our report makes it clear that we are not intending to start a general enquiry as we did in 1968. It mentions three specific areas on which we would like to concentrate.

The first item is related to futures studies or research. You will soon receive a separate letter, accompanied by a special questionnaire, regarding your views and activities in this area.

The two other items indicate our intention to revisit the scene of science policy in the light of the proposals that were put forward in Volumes 2 and 3 published in 1972 and 1973.

Your organization, if it existed in 1968, responded to our questionnaire which is reproduced in Annex B of Volume 1 of our report on science policy. Whether or not your department or agency existed in 1968, we would like you to answer that questionnaire and thus provide us with current information regarding your scientific activities.

In your response, you should take the following guidelines into account. The information requested is numerical or verbal and descriptive. For those questions requiring numerical data, we would prefer to get the actual figures, but if they are not readily available in your files, please give the best estimate and add any useful commentary.

With regard to the sections of the questionnaire requiring only a verbal descriptive response, we assume that this will not present a problem. What the Committee wishes to suggest as an overall guideline is that you concentrate on that part of the response which illustrates the existing process of science policy making and its implementation; the Committee will welcome your comments or judgements concerning future changes you believe would improve that process.

In addition, the Committee would like to receive from you a response not only to the specific recommendations, but also to the more general suggestions contained in Volumes 2 and 3 of its report on science policy and related directly or indirectly to your organization. In your reply, we expect that you will indicate the proposals that you have rejected and your reasons for this rejection. You should also identify those which have been accepted and describe how they have been implemented.

Finally, you should feel completely free to add any other advice, perception or information that may be useful to us. We would like to know the main trends which have appeared in the last few years regarding government involvement in science, technology and innovation; what are the most important developments that can be anticipated in the near future in this vital area; and how that government involvement can be made more effective to meet the needs of Canadians.

The Committee would like to receive your brief as soon as possible, but not later than the end of December. However, we do not intend to hear all government departments and agencies and I will communicate with you again later on to let you know if and when your organization will be invited to appear.

Our only purpose in undertaking this new enquiry is to help improve the formulation and implementation of Canadian science policy. For this reason, we hope that we will get your full cooperation.

Yours sincerely,

Maurice Lamontagne

APPENDIX "4"

Letter to NON-GOV. ORGANIZ. that presented a brief at
previous Committee hearing

14 October 1975

Dear X

Re: Forthcoming activities planned
by the Canadian Senate Special
Committee on Science Policy

Your organization greatly helped the Senate Special Committee on Science Policy by presenting a brief some years ago. You will undoubtedly be interested to know that the Committee submitted a report to the Senate on July 10, 1975, and then recommended that "it be authorized to consider and report on Canadian government and other expenditures on scientific activities and matters related thereto". This recommendation was approved on July 24, 1975.

A copy of the Committee's report to the Senate is attached herewith. You will see that the Committee intends to resume its "watchdog role" in three specific areas:

1. The futures research programs being carried out within government departments and agencies. We intend to concentrate our attention (i) on the futures research role being developed by the Institute for Research on Public Policy and (ii) on the need for coordinated national networks of futures research and information.
2. A systematic review of the implementation of the recommendations contained in the Committee's report on science policy, A Science Policy for Canada (see especially Volume 2, "Targets and Strategies for the Seventies", and Volume 3, "A Government Organization for the Seventies"); a list of recommendations is attached to this letter.

3. The critical evaluation of the criteria and techniques used by the government to review and assess expenditures and programs related to scientific activities. On February 28, 1974, the Honourable Jeanne Sauvé, who was then Minister of State for Science and Technology, announced that her Ministry "will be responsible for the development of a science policy framework against which individual policies can be viewed", that a science budget display "will be used for the evaluation of departmental and agency budgetary proposals for scientific activity", and that the Ministry of State for Science and Technology "will evaluate these proposals prior to final consideration and approval by Treasury Board and publish annually a report analyzing federal expenditures on science and technology". The Committee intends to investigate how these roles assumed by MOSST have been developed and how effectively they have been exercised.

Your organization has demonstrated a genuine interest in at least some of the topics the Committee will be considering and reporting upon. I urge you, therefore, to send us any views, counsel or information you believe would assist us in our forthcoming endeavour. You may want to give us, for instance, your assessment of developments in Canadian science policy which have occurred since you appeared before us in 1969. If you decide to send us a brief, we would hope to receive it as soon as possible, but before the end of December.

The Committee does not intend at this stage to hold a long series of hearings, as it did during its first enquiry. We cannot, therefore, undertake to hear all those who will submit briefs, but we will certainly give serious consideration to all the written representations we will receive.

Yours sincerely,

Maurice Lamontagne.

APPENDIX "5"

2nd. letter to all gov. Depts. and Agencies

Oct. 17, 1975

Dear

Re: Futures Studies Activities

In my letter to you dated September 23, 1975 regarding science policy, I indicated that I would send you a separate letter accompanied by a questionnaire on the futures research activities of your organization.

If you want to have the background of the present letter, you should refer again to the report that our Committee presented to the Senate on July 10, 1975. You have already received a copy of that document. In addition, a copy of our paper entitled, "Managing the Future: Conference on Anticipatory Institutions" will be sent to you upon request.

As you will see in that report, our interest in futures studies and information goes back to 1972 and has taken a major portion of our time since 1974. You will also note that the leadership role we had assumed in this area, because of the vacuum which then existed, has now been assigned to the Institute for Research on Public Policy. We have therefore decided to maintain our interest in this field but to fulfill a watchdog role. In making a survey of futures studies within the federal government, as part of its broader mandate, the Committee's specific objectives are:

1. to help develop coordinated national networks of futures research,
2. to consider how best the on-going activities in the futures studies area, within the federal government, can be monitored to ensure, insofar as this can be done, that coordination will be effectively achieved, and
3. to assess the catalytic and residual role of the Institute for Research on Public Policy in the development of these national networks.

The Committee needs your assistance in making its survey and I am hereby inviting you to respond to the enclosed questionnaire to the extent that the information requested is relevant to the activities of your organization. It might facilitate matters if you would identify for us a person on your staff with whom our personnel could establish and maintain contact.

We hope to obtain your response to the questionnaire, together with any additional comments that you may wish to make, as soon as possible, but not later than the end of December.

You will share our view, I am sure, that it is extremely important for Canada to develop a coherent futures studies program and to make sure that such research will have its full impact on decision making. The Committee believes that it is essential for a parliamentary group to participate in such a development and will welcome your support.

Yours sincerely,

Maurice Lamontagne.

Encl.

APPENDIX "6"

Letter to organiz. that participated in Barsony & Thompson report

24 October 1975

Dear

Re: Survey of Futures Studies

Your organization participated in the Economic Council of Canada survey of futures studies in Canada (Long-Term Forecasting in Private and Public Organizations in Canada: Results of a Survey by Andre Barsony and Fred G. Thompson, November 1972). I thought therefore, that you would be interested in knowing that the Senate Special Committee on Science Policy plans, among other things, to survey futures studies mainly within the federal government.

This survey was proposed as part of a report presented to the Senate on July 10, 1975, where the Committee recommended that "it be authorized to consider and report on Canadian government and other expenditures on scientific activities and matters related thereto"; this recommendation was approved on July 24, 1975. A copy of the Committee's report to the Senate is attached herewith.

As you will see in that document, our interest in futures studies and information goes back to 1972 and has taken a major portion of our time since 1974. You will also note that the leadership role we had assumed in this area, because of the vacuum which then existed, has now been assigned to the Institute for Research on Public Policy. We have therefore decided to maintain our interest in this field but to fulfill a watchdog role. In making a survey of futures studies within the federal government, as part of its broader mandate, the Committee's specific objectives are:

1. to help develop coordinated national networks of futures research,
2. to consider how best the on-going activities in the futures studies area, within the federal government, can be monitored to ensure, insofar as this can be done, that coordination will be effectively achieved, and
3. to assess the catalytic and residual role of the Institute for Research on Public Policy in the development of these national networks.

The Committee has asked all government departments and agencies to respond to a detailed questionnaire on their futures research activities. A copy of that questionnaire is also attached herewith. Since your organization has already demonstrated a genuine interest in this area, we invite you to respond to these questions to the extent that they are relevant to your activities. In addition, we hope that you will send us any views, counsel or information you believe would assist us in our forthcoming endeavour. If you decide to send us a brief, we hope to receive it as soon as possible, but not later than the end of December.

The Committee does not intend at this stage to hold a long series of hearings. We cannot, therefore, undertake to hear all those who will submit briefs, but we will certainly give serious consideration to all the written representations we will receive.

Yours sincerely,

Maurice Lamontagne.

APPENDIX "7"

QUESTIONNAIRE REGARDING FUTURES STUDIES

(You will undoubtedly appreciate the difficulties involved in the preparation of a questionnaire on such a new and still ill-defined topic as futures studies and their use in decision making. Moreover, because of our small staff, we have not been able to prepare different models of the questionnaire designed to fit the particular conditions of various types of organizations. If you find that the questions are too general, are not applicable as stated to your organization, or do not cover the subject as you see it, do not hesitate to rephrase them or add to them.)

1. Futures studies can be defined as systematic research through one or more methodologies, into indicative or normative medium term and long term futures for the purpose of identifying threats and opportunities and providing a broader and less short-sighted basis for decision making.

Is this definition acceptable to you?

If not, give the alternative that you prefer.

2. Does your organization use the term futures studies for the type of activity described above or an alternative (e.g., futures research, futurology, futuristics or forecasting). Please state alternative if one is used.
3. Does your organization conduct or sponsor any futures studies?

A. The Planning of Your Futures Studies

4. How do you perceive your needs for futures studies?
(Advocates of futures studies make the following assertions:
 - a) These studies can provide an "early warning" system and help identify emerging problems that might become crises.

- b) They can provide an information environment which will help managers to broaden the basis and extend the time horizon of their decision-making process, thus increasing the probability that their actions will have their intended effects and impacts.
- c) Futures studies help develop a sensitivity to change, an understanding of the process of change and the ability to react to change, thus generating a greater capability within management to make more quickly the internal organizational improvements necessary for successful goal accomplishments.

If you agree with this perception of needs that can be met by futures studies, list them in terms of your own priorities and explain why. If you do not agree, indicate the needs that would better reflect the experience and perception of your organization.)

- 5. How are futures studies planned and initiated in your organization; do your senior managers actively participate in that planning or is the initiative left to researchers?
- 6. Before initiating a futures research program, how do you make sure that the need you have in mind is not already met by existing studies made in Canada or abroad; do you have access, for instance, to a monitoring service giving you information on research done or going on elsewhere in the area that concerns your organization?

B. Your Futures Research Programs

- 7. How many futures studies groups operate within your organization? Please describe the specific needs which any one group is expected to meet and give details regarding staff, budgets, disciplines and projects involved and any other information you believe would be valuable concerning your current activities in this area.

8. Does your organization retain consultants or outside contractors to meet your research needs in this area? In the affirmative, describe the main features of the contracts which have been awarded in 1974 and 1975 (name of contractors, nature of projects, amounts involved, etc.)
9. Are you offering grants upon request to outside organizations in order to support their own futures studies activities? In the affirmative, describe the guidelines that you apply and the general features of the grants that have been awarded in 1974 and 1975 in the same manner as in (8).
10. Do you envisage to maintain or increase the budget devoted to futures studies during the next few years and if so,
 - a) in response to what needs?
 - b) in what form of expenditures: in-house, contracts or grants? Explain.
11. What are the futures studies methodologies being utilized by your staff (the Delphi method, extrapolation of trends, morphological analysis, scenarios, cross impact matrices, the dynamic forecasting model developed by Jay Forrester and others)?
12. Have you conducted any work in order to improve and extend a particular methodology? Describe briefly.
13. Is the main technological assessment effort for your organization conducted within your futures studies group(s), within your organization by a separate group, or under contract by outside consultants?
14. Give us a brief list of books, articles or reports that you have found to give a useful account of the nature and scope of futures studies and their introduction into the managerial or decision-making structure of your organization. Please limit the list to about 10 items. (This is not a request for a library bibliography but for an indication of the literature which the managers of your organization have found to be of value in their own work.)

C. Use and Diffusion of Your Futures Studies

15. How and at what level(s) are the results of futures studies fed into your decision-making structure?
16. Give some concrete case histories related to the internal use by your senior managers of the results of futures studies conducted or sponsored by your organization, including the impact they have had on decision-making.
17. What are the steps taken by your organization to ensure the best possible diffusion of its futures studies (either in-house or contracted out) within and outside of the federal government?
18. What are the main restrictions limiting the diffusion of your futures studies; do you have any suggestions for reducing those restrictions?
19. Give the title and a brief outline of the futures studies reports sponsored by your organization which are already or will be available in 1975 and 1976 to the Canadian public.

D. Futures Studies Outside Your Organization

(This section may appear to duplicate question 6. However, it should be seen as complementary and as dealing with broad or macroscopic research and with specific studies considered to be outside but related to the area of immediate concern to your organization.)

20. Do you believe that there is a need for an integrated and continuing Canadian program of macroscopic futures research which could give an overview of broad trends and alternative futures within an international outlook and serve as a framework and reference for your own specific studies?

21. If such a need exists, how in your view could it best be met (e.g., the establishment of one or more centres within or outside the federal government; the coordination of current or of extended activities of existing agencies)?
22. Do you have easy access to specific futures studies in areas related to yours and made by
 - a) other government departments and agencies;
 - b) non-governmental organizations in Canada;
 - c) organizations outside of Canada.
23. If this access is not satisfactory, how would you propose to improve it (e.g., the creation of a Canadian information centre and relaying station with which you would be linked; assignment of this responsibility for gathering and diffusing information to an existing agency)?
24. Are your senior managers involved in periodic discussions of medium-term and long-term threats and opportunities within the scope of your mission with colleagues working in related areas in other governmental and non-governmental organizations?
25. If such systematic discussions take place, would you describe how they are organized and indicate whether they have led to a better mutual understanding of these threats and opportunities.
26. If such discussions do not take place, do you think that there is a need for them and if so, how should they be organized?

APPENDIX "8"

BRIEF TO

THE SENATE SPECIAL COMMITTEE ON SCIENCE POLICY

PRESENTED BY

THE HONOURABLE C. M. DRURY

MINISTER OF STATE FOR SCIENCE AND TECHNOLOGY

NOVEMBER, 1975

TABLE OF CONTENTS

INTRODUCTION.....	
A. BACKGROUND.....	
B. SCIENCE POLICY AND THE ROLE OF MOSST.....	
The Development of Science Policy.....	
The Role of MOSST.....	
C. THE DEVELOPMENT OF MOSST'S ORGANIZATION AND PROCEDURES.....	
Early Experiments in Organization.....	
MOSST's Responsibilities in Relation to Budgetary Matters.....	
MOSST's Responsibilities in Relation to International Affairs.....	
MOSST's Responsibilities in Relation to Industrial Strategy.....	
MOSST's Responsibilities in Relation to the Universities and the Provision of Highly Qualified Manpower.....	
MOSST's Role in Technology Assessment.....	
D. MAJOR POLICY INITIATIVES.....	
E. THE GOVERNMENT'S POSITION REGARDING THE GRANTING COUNCILS AND THE SUPPORT OF BASIC RESEARCH....	
F. THE GOVERNMENT'S POSITION REGARDING THE SCIENCE COUNCIL OF CANADA.....	
G. THE GOVERNMENT'S POSITION REGARDING THE PERFOR- MANCE OF S&T ACTIVITIES IN FEDERAL DEPARTMENTS AND AGENCIES.....	
H. OTHER MATTERS OF CONCERN TO MOSST IN WHICH THE SENATE COMMITTEE HAS EXPRESSED A SPECIFIC INTEREST.....	
The Federal Government's Relationship With Scientific Institutions.....	
S&T Information.....	
Futures Research.....	

APPENDIX "A"

Budgetary and Manpower
Statistics

APPENDIX "B"

Organization Charts

APPENDIX "C"

Case Histories of Major
Science Policy Initiatives

INTRODUCTION.

1. Senator Lamontagne in his letter of September 17, 1975, inviting the presentation by MOSST of a brief to the Committee, made specific reference to the role of MOSST as the main central agency for science policy and its involvement in the government's response to the Senate Committee's proposals. The Ministry is anxious to assist the Senators in every way possible and in preparing this document we have aimed at three specific objectives: to present a clear picture of the developments in federal science policy and organization that have taken place since the establishment of the Ministry; to explain how the Ministry's role and procedures have developed and, in meeting these two objectives, to identify as far as possible the extent to which the recommendations and suggestions of the Senators have been followed. Many of the recommendations were of a nature that called for a response from the government as a whole rather than the Science Ministry. For this reason, it has seemed appropriate that the Minister should himself respond to the Committee since he is in the position to speak for the Government regarding matters of organization and broad policy.

A. BACKGROUND.

2. The Senate Committee's examination of Canada's policies, practices and organization in science has undoubtedly constituted a major landmark in the history of science. It has been recognized internationally as probably the most complete and searching examination of its type made anywhere in the world and the three volume report of the Committee has been read with deep interest throughout the scientific community.

3. The Committee's report has been and continues to be required reading for all those in government who are involved in the development of science policy and organization, and the Committee's

recommendations have been discussed, analyzed and evaluated on innumerable occasions. Some have been accepted, others have not. Many have been partially adopted.

4. The Committee in the Foreword to Volume 3 of its report acknowledge that - "Many of the recommendations contained in the second volume of its report, Targets and Strategies for the Seventies, have been implemented or accepted in principle by the Canadian Government".

5. The Committee made a number of recommendations concerning its own future and the actions that Parliament should take such as the organization of a group of Parliamentarians from the Senate and the House of Commons to study science policy matters. It would be inappropriate for the Ministry of State for Science and Technology to comment on these recommendations other than to confirm strong support for any new mechanisms by which Parliament can be increasingly informed and concerned regarding science and its impact on Canadians.

6. The Ministry of State for Science and Technology (MOSST) came into being in the midst of the Senate Committee's deliberations and it may be helpful to reiterate briefly some of the main events that led up to its establishment.

7. The Royal Commission on Government Organization recommended in 1963 that senior responsibility for science policy be placed on a single Cabinet Minister and that a suitable secretariat be established to serve this Minister and the Cabinet. The Commissioners did not however recommend the setting up of a department of science because they felt that scientific activity, like economic activity, pervaded such a large segment of the Public Service, that attempts to centralize it would impair the effectiveness of the many departments of which it was an important part.

8. In January, 1964, Dr. C. J. MacKenzie made a report to the Prime Minister on Government Science and stated that he was in

general agreement with the Glassco Commission's concept of a Central Scientific Bureau but thought that it should be in the Prime Minister's Office rather than reporting to the President of the Treasury Board as the Glassco Commission had recommended.

9. The OECD examiners in their "Review of Canada's National Science Policy" in 1969, recommended the establishment of a Minister of Science assisted by a Central Scientific Secretariat. They also recommended the creation of a Government Research Board to establish a balance between government targets and the research work done at the department level.

10. There was clearly a trend in all these recommendations towards a centralization of science policy efforts and the development of a mechanism whereby the Federal Government could develop such a policy and oversee its implementation.

11. The changes stemming from these investigations did not in the final event correspond to any one particular recommendation. A Science Secretariat was formed within the PCO and reported to the Secretary to the Cabinet.

12. This was the situation when, in November, 1967, the Senate adopted a resolution setting up a special committee to review the science policy of Canada.

13. The Government's decision to establish a Ministry of State for Science and Technology was reached in the Fall of 1970, while the Senate Committee was in the process of preparing Volume 1 of their report. The Ministry was not, however, brought into being until August, 1971.

14. The second volume of the Committee's report was released in January, 1972, at a time when the new Ministry was in the early stages of finding its feet. The recommendations in this volume were primarily concerned with the fundamental thrust of Canadian Science, the level of funding and the need to build up the scientific and technological strength of Canadian industry.

MOSST made an extensive appraisal of the Committee's recommendations and found itself to be well in tune with the Committee's views on the importance of supporting innovation in Canadian industry.

15. The major organizational changes recommended in Volume 2 by the Senators in areas such as the Granting Councils and the NRC laboratories presented issues that, while of prime concern to MOSST, were on a scale demanding government rather than Ministry action. The development of a federal position on these issues has since culminated in draft legislation. MOSST has contributed to the discussions that have led up to this draft legislation.

16. In their third report, the Senate Committee were in the position of having studied MOSST's mandate and terms of reference and of having observed the Ministry in action over a short period. This volume dealt with the Ministry's role in some detail and made a number of recommendations specifically directed to it.

B. SCIENCE POLICY AND THE ROLE OF MOSST.

The Development of Science Policy.

17. In the concluding paragraph of Volume 1 of their report, the Senate Committee stated . . . "We must develop a coherent overall science policy so that we can not only meet our economic objectives more effectively but also more realistically face our social problems."

18. This challenge was accepted by the Ministry of State for Science and Technology which, from the day of its inception, faced the fact that it could not deal rationally with specific problems nor establish sound working relationships with other government departments and agencies until it had developed, and had had accepted by Cabinet, a basic science policy framework that would

define the essential role of the federal government in the field of science. The primary difficulty in developing such a framework was the insistence of some authorities in both government and the academic sector that science policy should be a single indivisible entity. The Ministry found this concept to be unworkable and there is nothing in the Senate Committee's report to indicate that the Committee espoused it. The Ministry has concluded, and the Cabinet has now agreed that Federal Government science policy includes the sum of policies in three distinct areas.

a) Policies for the support of science under which are included:

- the support of post-graduate university research;
- the arrangements for scientific representation abroad;
- the support of Canada's participation in international scientific organizations;
- provision of scientifically trained manpower and dissemination of scientific information; and
- provision by the government of certain basic research facilities.

b) Policies for the application of scientific and technological resources under which are included:

- policies developed within departments and agencies for the use of science and technology in support of their objectives;
- policies developed through cooperative inter-departmental means for the achievement of broad multidepartmental objectives having a high technological content; and
- policies to govern procedures involved in the use of science and technology such as the "Make or Buy" policy.

- c) Science in Public Policy, the active participation of scientifically trained personnel in the development of long term national strategic policies and the introduction of scientific knowledge, analysis, and methodology into such planning activity.

The Role of MOSST.

19. MOSST has experimented with a number of organizational structures during its lifetime and its role has been subject to a variety of interpretations. The experience of the formative years will be further discussed in the next section of this document but it is appropriate at this juncture to examine the role as it is now maturing and comment on the extent to which it matches the role recommended in the Senate Committee's report.

20. The Senate Committee felt strongly that MOSST's role as described in the Order in Council came . . . "within the framework of the coordination model", and lacked the authority needed for an effective central agency. The Committee recommended that the Ministry's role be within the framework of the "concerted action" model and specifically that the Ministry's terms of reference be modified to give it budgetary authority in relation to science.

21. While the Ministry tended to agree with the Senators that its role should be more positive than that of its predecessor the Science Secretariat, it could not agree with the Committee's recommendation that it be given authority over science expenditures. The reasoning behind this stemmed from the Ministry's contention - a contention that has since been confirmed as one of the main pillars of the Federal Government's science policy framework - that science is not an end in itself but a means of solving national problems and achieving national goals. The Government's interpretation of national goals and its perception of national problems are reflected in large part in the objectives set for its

departments and agencies. These objectives, in turn, form the basis for the development of programs and the allocation of resources. The level of funding provided for a specific departmental program should reflect the importance of its objectives; and within the program, science and technology must compete for funds with alternate means of meeting these objectives.

22. It follows that, since science is not, in itself, a program but rather one of the means used in the performance of programs, a science budget in the conventional sense (i.e. as a basis for resource allocation) cannot reasonably be accommodated in the existing structure and procedure of the Government; nor can the Government organize its decision-making processes in such a way that final judgements on the mix and balances of science expenditures can be made separately or by a different authority than judgements about the allocation of other resources to the Government's objectives.

23. The Government can however, through the Ministry of State for Science and Technology, ensure that plans and budgets for scientific activities are screened by competent analysts knowledgeable in program objectives and operations as well as in scientific activities across the Government, and that advice by the Ministry is effectively introduced into the decision-making process.

24. MOSST's role may be considered to lie somewhere between the coordination and concerted action models. The Ministry sees itself as part of the central policy making apparatus, working in conjunction with PCO, Treasury Board Secretariat and major science departments in the preparation of proposals to Cabinet. It will complement and coordinate rather than duplicate the scientific or policy analysis expertise in departments and central agencies. It will bring to bear its knowledge of Government objectives and operations and of scientific activities in departments,

its growing analytical competence, and the impartiality that comes from not having any operating programs of its own. In particular, it will assist a "lead" department or take the initiative itself where no "lead" department exists, in seeking solutions to problems of science policy or programs, including the coordination of the programs where more than one department is involved.

25. In accordance with the philosophy expressed in the third arm of the new science policy - Science in Public Policy - the Ministry will be particularly concerned with providing a science input to long-term national strategy, and within this context, note is taken of certain recommendations made by the Senate Committee regarding the overall national expenditure on R&D and the priorities that the Senators felt should be given to certain fields of science.

26. The Senate Committee placed strong emphasis on the need for long-term planning and the establishment of national R&D priorities. MOSST has fully supported the idea of forward planning, but has reservations regarding the Committee's proposal that national expenditures on R&D should reach 2.5% of the GNP by 1980 and that approximately 10% of this effort should be devoted to basic research. National problems and priorities change over the years, and so must the judgements made by Government about the balance of resource inputs to the programs for dealing with them. A fixed GNP-related target for the input represented by science is not therefore meaningful over the long haul. MOSST takes the view that the amount of curiosity oriented basic research performed should probably reflect the wealth of a country in so far as it is directed at a search for new knowledge, while reflecting national needs in so far as it is directed at the training of skilled personnel. The amount of applied research and development effort should be related directly to the solution of national

problems. The means of supporting basic research are discussed further in a later section.

27. The Committee recommended that, at least during the 1970's, the Government's emphasis in support of basic research should be on the human sciences. The Ministry agrees and has highlighted the importance of the human sciences in its advice to Cabinet.

C. THE DEVELOPMENT OF MOSST'S ORGANIZATION AND PROCEDURES.

Early experiments in organization.

28. The Ministry of State for Science and Technology was launched as an experiment in government organization and has had to make its way under difficult circumstances. The Senate Committee recommended that an outside task force be set up to review the organization and structure of the Ministry. However, it is not an exaggeration to say that the Ministry has never ceased to be the subject of review since the day it was founded and has undergone several changes in organization and emphasis as it sought to establish its proper role and method of operation.

29. The original nucleus of the Ministry was provided by the staff inherited from its predecessor, the Science Secretariat of the PCO. As of September 30th, 1971, there were 41 continuing employees on strength. This number has built up over the 4 year period to the present authorized strength of 169. The budget for the first year (1971-72) was \$1.1 million and that for the current year \$4.9 million. Charts describing the budget and personnel complement for each year are given in Appendix 'A'. The main organizational structures adopted by the Ministry are given in Appendix 'B'.

30. The early problems of MOSST have been well described in a Science Council Background Study - "Knowledge, Power and Public Policy". MOSST is a central agency without the power bases that are the strength of the other two primary agencies, PCO and the

Treasury Board. There were no obvious fields of decision-making responsibility for it to step into. Whatever it did was likely to transgress the boundaries of other departments and agencies. Its proper course was to try to provide a new and needed advisory and coordinating capacity to assist the central agencies, to establish bonds of confidence with departments and to take initiatives in areas that seemed to require it.

31. Mistakes were made in developing this role. At the outset, MOSST had perhaps too high a public profile and tended to make public pronouncements on matters that concerned other departments and agencies. There was also a temptation to take on everything at once and not concentrate the limited resources of the Ministry on a few important tasks. The Ministry also had difficulty in finding the right organizational structure to carry out its role most effectively.

32. It is now clear that a small central agency cannot monitor and comment on every aspect of day-to-day science activity in government. The sheer volume of material passing through the Cabinet Committee system alone, a great deal of which has scientific and technological aspects on which MOSST could have some comment, would totally swamp the organization.

33. The Ministry is now taking an entirely new approach to its principal role, based on a highly selective choice of policy issues and projects. A flexible organization is being created to operate mainly on a task force basis. This matrix approach is not of course a new idea. It has been employed with success in both the public and private sectors. It permits a small group of policy analysts and scientists, or others appropriate to the problem under study, to be organized as a team for a specific task and to be reassigned to handle other problems as they arise.

34. In order that those outside the Ministry shall have some means of identifying who to approach in broad areas of concern,

the Ministry has been organized for administrative and communications purposes into three branches; Government, Universities and Industry. Each branch will have senior project directors who will normally take the lead in organizing and carrying out policy analysis projects of special relevance to the branch. The officers of all branches, however, may be called upon to take part in projects in any field where their experience or abilities is appropriate. The Ministry will expect to obtain assistance from other departments and agencies or from outside government when it is needed for certain project studies.

35. Within the organization, certain units have been identified to carry out continuing responsibilities of the Ministry. While these units will operate mainly on a continuing rather than on a project basis, specific officers within them or indeed the unit as a whole, may be tasked for certain portions of study projects. Appendix 'B' contains the present organization chart and identifies the "continuing activity" units.

36. The Senators have emphasized the need for MOSST to have staff with policy analysis and development experience. The Ministry agrees completely with this view and will continue to apply it in its staffing policies.

37. The role of the Minister was a matter of some concern to the Senators who specifically recommended that he be a member of Treasury Board and of the Priority and Planning Committees. The prerogative for appointing Ministers to Cabinet Committees rests, however, with the Prime Minister, and the Ministry is therefore not in a position to comment on this issue.

MOSST's responsibilities in relation to budgetary matters.

38. The Senate Committee suggested that departments should separate their budgetary proposals for scientific activities from their other operational programs. The science budget proposals

would then be submitted to MOSST for review and assessment. The Ministry would in turn submit them with recommendations for approval to an interministerial committee presided over by MOSST's Minister. The Committee's views would then be presented to the Treasury Board as a package. If Treasury Board judged the package too high in the light of overall government priorities and budgetary constraints, the amount of the cut necessary would be referred to the interministerial committee to determine how and where cuts should be made, again with the advice of MOSST. When approved, the science estimates would be published separately, to give Parliament and the public a better idea of the size and distribution of the Government's scientific activities.

39. While, for the reasons set out earlier, the Treasury Board remains responsible for the approval of science proposals in the context of departmental programs, procedures have been established for the review and assessment by MOSST of proposed science expenditures, and for advice thereon to be provided to the Treasury Board Secretariat. Highlights of the approved science estimates are published separately in "How Your Tax Dollar Is Spent". Thus, except for the creation of an interministerial committee to approve a science budget, substantial changes have been made in the budgetary process for science and technology that are generally in accord with the Senate Committee's recommendations.

40. A Program Review and Assessment Group was established in the Ministry in 1973 to provide advice and support to operating departments and agencies, and to the Treasury Board Secretariat (TBS), on budgetary, program, and management issues having a significant scientific and technological content.

41. The interactions between MOSST and TBS take place in the review of science proposals by departments and agencies within the framework of submissions for program forecasts, main estimates and supplementary estimates. Procedures for carrying out these

cooperative efforts and for the computerized science expenditure display system which provides historical and current manpower and expenditure data in support of the review process, have been developed and improved through the 1975-76 and 1976-77 budgetary cycles.

42. The separate preparation of data in connection with science expenditure proposals was initiated with the Treasury Board call letter to departments for program forecasts in January, 1974. The call letter included a request, on behalf of, and in support of MOSST, for detailed information on current and proposed scientific expenditures. The data thus obtained, together with past expenditure trends based on annual Statistics Canada surveys of federal science expenditures, were incorporated in a computerized data base, along with Main Estimates data for 1975-76, in the fall of 1974.

43. The data base included information on science resource requests and made possible displays categorized by program and activity, by research and development and related scientific activity, for both the human and natural sciences. Expenditures could also be categorized by performer (intramural, industry, university, others), by region; and to some degree by area of application.

44. Overall trends, as indicated by the science expenditure data, as well as individual requests for new activities were reviewed in the context of government priorities and objectives, with particular attention being given to the response of departments to, for example, the Make or Buy, Oceans or Space policies. Specific recommendations were made to MOSST and TBS managements, and to MOSST's Minister during 1975-76 Program Forecast and were updated during the course of 1975-76 Main Estimates Review. The highlights of the Main Estimates decisions were published at the same time as Main Estimates, in "How Your Tax Dollar Is Spent". Thus, science budgetary information was, for the first time, made

available with Main Estimates data.

45. MOSST has also been advising TBS on requests to TBS for approval of program plans developed by departments, subsequent to their inclusion in program forecasts, and MOSST's Minister is briefed on selected submissions to the Treasury Board.

46. Over the past year, departments have increasingly been seeking MOSST advice during the development of program plans and program forecasts prior to their submissions to TBS. The Treasury Board strongly supports this MOSST role, and TBS has advised departments, who have not done so, to consult MOSST before putting forward submissions.

47. Significant improvements in the MOSST-TBS interaction have occurred during the 1976-77 Program Forecast reviews just recently completed. MOSST carried out a systematic analysis of individual departmental "B" budget requests and made recommendations to TBS with respect to them. In providing advice to TBS on the program forecast, the Ministry has been on the lookout for duplication of effort, lack of adequate interdepartmental coordination, research not related to departmental mandates, and non-uniformities in the planning, budgeting and management of S&T activities.

48. Thus, while MOSST has not sought the central role in the development and approval of a science budget, recommended by the Senate Committee, a working relationship has been developed with departments and TBS which is providing increasingly effective support to departmental program planning, and increasingly useful advice to TBS.

MOSST's responsibilities in relation to international affairs.

49. Science information from other nations is extremely important to Canada and our policies in science and technology must take account of what is happening elsewhere. Opportunities for international cooperation in scientific and technological fields are

increasing and Canada is involved in a large number of understandings and agreements that are highly scientific in content.

50. The responsibility for international science is shared between MOSST and the Department of External Affairs, and involves a very close consultative relationship between them as well as with other departments. External Affairs is responsible for international liaison and communications, both bilateral and multilateral. The Ministry, while recognizing the responsibility of External Affairs to manage Canada's overall international activities, considers itself responsible for developing appropriate policies in relation to international science matters. Where appropriate, it may provide leadership for delegations or chair interdepartmental meetings to establish national positions.

51. The Senate Committee in the second volume of their report emphasized the need for a good scientific and technological network on R&D activities at home and abroad, and the futility of attempting to repeat a scientific discovery or develop an innovation that has already been introduced elsewhere.

52. The Ministry is in full agreement and has had a major role in increasing Canada's scientific representation abroad and in promoting scientific and technological missions to foreign countries including China and Japan. Since MOSST was formed, four additional Science Counsellor positions have been established bringing the total to eight.

MOSST's responsibilities in relation to industrial strategy.

53. MOSST has, since its earliest days, had a major interest in the problems of Canadian industry and the possibility of overcoming these problems by strengthening industry's technological base.

54. The Senate Committee was very concerned at the low level of industrial R&D in Canada and the proportionally high level of R&D performed in government departments. This general concern has also

been expressed in numerous briefs and letters to Ministers and in reports of outside bodies.

55. MOSST put forward the proposition that if government procurement in scientific fields could be steered into industry rather than into government laboratories, it would have a major beneficial effect. This proposal led to the development of the Make or Buy policy and its adjunct the Unsolicited Proposals Program. The development of these policies is described in more detail in an appendix to this brief.

56. The acceptance by the Government of the Make or Buy policy was a distinct achievement for MOSST. It involved intensive consultation and persuasion since the concept tended at first to appear contrary to the individual interests of departments.

57. The importance of the industrial aspects of science and technology cannot be overestimated and while the primary responsibility for relations with Canadian industry rests, of course, with the Department of Industry, Trade and Commerce, MOSST from its early years has expended a major part of its effort on industrial matters. The Ministry continues to give a very high priority to industrial issues: indeed, it is currently reviewing the operation of the Make or Buy policy and examining the possibility of extending its application. A review of industrial research and development incentive programs is also underway, as is the examination of the recommendations of a report on the availability of risk capital for technological innovation which was prepared for the Ministry by Mr. Robert Grasley.

58. In 1974, MOSST made representations to Cabinet on the need to enhance the international competitiveness of selected sectors of Canadian industry through the development of comparative advantages based upon technological excellence. Cabinet instructed MOSST to set up and chair an Interdepartmental Committee on Industrial Technology Policy. Working papers prepared for this committee have

dealt with the shortcomings of existing industrial R&D assistance programs and the general issue of industrial R&D support. These issues are presently under consideration.

59. A close association exists between the above Committee and the Interdepartmental Committee on Industrial Policies and Strategies set up by the Department of Industry, Trade and Commerce. It is understood that IT&C will be briefing the Senate Committee separately on the working of this Committee and on other recommendations directed specifically by the Senators to that Department.

60. The Senate Committee's recommendation regarding the creation of the Canadian Innovation Bank (CIB) has been partly implemented in the context of the Federal Business Development Bank (FBDB). A recent MOSST funded study (The Grasley Study referred to in para. 57.) supports the need to provide venture capital and specifically recommends awards for inventors.

61. In relation to the Senate Committee's recommendation that MOSST and IT&C develop a "marriage bureau" to expedite partnerships between Canadian firms and complementary companies in other countries, MOSST is advised that, in recognition of the complexities of such an undertaking, IT&C is in the process of forming a highly specialized group within the department for this purpose.

62. The Committee expressed concern regarding the training of R&D managers. As a result of a study at Queens University sponsored by MOSST, the Canadian Manufacturers Association has initiated plans to establish a training course on innovation management at one of the leading business administration schools in Canada. The formation of the Innovation Management Institute of Canada, an independent group which plans to establish R&D management courses at a number of centres across Canada, is also a step in the direction called for by the Senate Committee.

MOSST's responsibilities in relation to the Universities
and the provision of Highly Qualified Manpower.

63. Although the Federal Government makes a major contribution to higher education through federal-provincial fiscal transfers, its direct involvement is limited to the support of post-graduate research. MOSST has been involved since its formation in numerous studies of the granting system through which the government supports such research. Its aim has been to thoroughly investigate the many issues and problems associated with the government-university interface and develop mechanisms that satisfy both the government and academic constituencies. Meetings have taken place with university authorities at all levels and also with officials of the Granting Councils. There are many important issues to cover; trends in employment of those with post-graduate training, the effects of inflation, the question of the indirect costs of research and who should pay for them are examples.

64. The Senate Committee indicated major concern regarding Canada's ability to develop the needed future supply of highly qualified manpower and made a number of specific recommendations along this line. MOSST shares the Senators' concern and takes the position that the level of support provided by the Government in any particular scientific discipline, including support of graduate students, should be responsive to foreseeable demands for research trained graduates.

65. In support of this philosophy, the Councils will need to gain an insight into the training and deployment patterns of university educated persons generally and of research trained persons in particular. Accurate information on this subject is not readily available for all disciplines. The post-census Highly Qualified Manpower survey, jointly sponsored by the Ministry of State for Science and Technology and Statistics Canada,

and the analyses which will subsequently have to be carried out represent an attempt to improve the information on the subject, and should assist the Councils in their decision-making.

MOSST's role in technology assessment.

66. MOSST is particularly concerned with providing a science input into the long-term national planning. As part of its ongoing program, the Ministry has established a Technology Assessment Division within the Industry Branch which is its central focus for assessment studies. Its main role is to provide assessments of likely advances in science and technology, their alternatives and effects on the quality of life in Canada. The assessments are designed to provide essential background for the policy formulation and advisory roles of the Ministry.

67. These studies are selected with due recognition of the potential contribution which they can make to national priorities. Proposed studies are then reviewed by the Project Management Committee of MOSST and either approved, modified or postponed for later consideration.

68. In the category of long-term impact R&D, MOSST has recognized the need for technological assessment in the areas of solar, fusion and hydrogen energies. Following a detailed study funded by MOSST and the Atomic Energy Control Board with assistance from the Departments of Supply and Services and National Defence, a report was released in June, 1975, that examines Canada's options for R&D in fusion systems. The Government, in undertaking the study, recognized that nuclear fusion is an important area of science which may contribute in an important way to the national long-term energy needs.

69. A comprehensive assessment, funded by MOSST, of solar energy systems and their potential for Canada, was prepared by the Brace

Research Institute. The fusion and solar energy reports were made available to the Interdepartmental Task Force on Energy R&D and considered in establishing the R&D priorities. At present, a report on the general subject of hydrogen as an element in the national energy base is being prepared. It will be completed by the end of 1975 and it too will be submitted to the Task Force. These three areas of energy technology coincide precisely, though not by design, with the topics in the International Energy Agency of OECD R&D program which deals with new energy sources and the longer range problems.

D. MAJOR POLICY INITIATIVES.

70. In an earlier comment regarding the role of MOSST, the point was made that the Ministry would take the lead in promoting policy development studies or expediting specific programs when it was clear that the necessary organization or initiative were lacking.

71. MOSST has on a number of occasions identified problems or opportunities in high technology areas that were not receiving adequate attention and has taken the initiative in bringing together the necessary departments and organizing the development of policy.

72. Two types of policy are involved: policies for the development and use of technology in areas of priority concern such as the oceans, space, food and energy (these will usually be areas which do not fall within the statutory responsibility of any one department or agency), and policies governing general procedures relating to the use of S&T resources. The latter will be policies such as "Make or Buy" which the government wishes observed by all departments and agencies.

73. MOSST has had a full central role in two of these R&D policy developments: "Make or Buy" and "Oceans Policy", and a

major role in the development of "Space Policy". The Ministry has had a participating role (under EM&R leadership) in developing policy for Energy R&D. The history of these is given in Appendix 'C'.

74. The procedures used in these major policy study initiatives differ from one to another. The general practice has been to assemble an interdepartmental committee at senior level to give general direction to the work and to ensure reasonable balance and accordance with the Government's existing policies and intentions. Under this committee there would be formed a group of experts from appropriate departments who would be responsible for providing information and taking part in the analysis and development of policy proposals.

75. Outside consultants may be brought in to give specific advice or, as in the case of the Ice Covered Waters Study (described in the case history of the Oceans Policy), to act as central coordinator of the study.

76. Within MOSST a senior officer (usually at project director level) will be responsible for the general organization and running of the study program and the Ministry may, if appropriate, provide a secretariat in support of it.

77. Once a policy proposal has been completed and agreed to by the main committee, the Ministry will, in conjunction with appropriate departments, decide who should present it to the Cabinet. It will often be appropriate that such a policy be put forward by a number of Ministers.

78. The acceptance by Cabinet of a policy proposal stemming from this procedure does not necessarily mean that MOSST has no further part to play. The Ministry may be instructed by Cabinet to take further action such as setting up an appropriate co-ordinating mechanism. MOSST will, of course, continue to monitor the S&T aspects of both new and existing policies.

E THE GOVERNMENT'S POSITION REGARDING THE GRANTING COUNCILS
AND THE SUPPORT OF BASIC RESEARCH.

79. Canada's scientific capability can be measured in terms of the number and calibre of its scientists, the excellence of its scientific facilities, its ability to generate, store and retrieve scientific knowledge, and its ability to obtain needed scientific knowledge from outside sources.

80. The Federal Government encourages and supports the improvement of Canada's scientific capability through its support of post-graduate university research (an important component of post-graduate training), its provision of special facilities and equipment, its arrangements for scientific representation abroad, and its support of Canada's participation in the activities of international scientific organizations.

81. Research stemming from the curiosity of individual scientists is the process by which knowledge is generated and the foundation of the whole edifice of scientific and technological achievement. Some experience in research is an essential part of the scientist's training and his performance of research in the universities gives strength and vitality to the whole academic system. Furthermore, it assures that Canada has a capability to identify and assimilate new scientific knowledge.

82. The Senate Committee made a number of recommendations concerning federal support of basic research and suggested a revised granting organization consisting of a Canadian Research Board with three foundations. These recommendations, together with others, received very intensive study and in the spring of 1974 the Government reached a number of fundamental decisions which have since been translated into draft legislation.

83. All the studies of the granting council system have recommended organizational changes to strengthen it, improve the balance between the support of the various disciplines, increase the

emphasis on interdisciplinary research and harmonize procedures. The alternatives offered have ranged from retention of the present system to a single granting council covering all disciplines. The Senate Committee's proposals had an attractive neatness, simplicity and symmetry, but they implied a disassociation of curiosity-oriented basic research from mission-oriented basic research and a rather strict disciplinary basis for the organization of the granting foundations.

84. The Government's position tends to be more flexible. While maintaining the fundamental criterion of excellence as a basis for supporting university research, the Government wants to encourage scientists to tackle problems that relate to national needs and objectives. Furthermore, it places much emphasis on the need for interdisciplinary research and will encourage universities to relax the disciplinary boundaries of former years. In summary, the Government, while not of course using grant assistance to support research directly related to departmental missions, favours a more flexible system with greater stress on relevancy to national needs. These needs are not limited to research results but also include the development of trained manpower, the maintenance of a regional balance in research work and the build up of excellence in fields of specific importance to Canada.

85. In order to implement this policy the Government has announced its intention to make certain structural changes in the granting system. These changes will be detailed in the legislation but, as Senators will be aware, the Government's intentions have already been made public in the Speech from the Throne, and in a number of Ministerial speeches.

86. It is intended that there shall be three granting councils; a Social Sciences and Humanities Research Council, which will be responsible for the social science and humanities support previously provided by the Canada Council, a Natural Sciences and Engineering

Research Council which will consist of the present NRC granting function separated from the NRC laboratories, and the Medical Research Council which will retain its present functions.

87. The Canada Council will, if this legislation is approved, be concerned entirely with the arts. The establishment of a separate granting agency for the social sciences and humanities will give the added emphasis that is seen to be needed in these fields - emphasis that was specifically recommended by the Senate Committee.

88. With one exception, all studies of the Granting Councils have recommended the separation of the granting and laboratory functions of the NRC (the Science Council agreed that separation would take place eventually as a matter of course, but did not recommend that such a step be taken at the time of writing, 1969). The main argument in favour of separation has been that the management of both functions would be enhanced. The Senate Committee felt it particularly important that the management of the laboratories be free of the granting responsibility in order to be able to devote more time and attention to the laboratory function. These and other factors were considered when the Government decided that the functions should be separated. The future of the laboratories will be discussed in the next section in relation to government performance of S&T activities.

89. Suggestions were made by the Senate that the NRC support for the biological sciences be transferred to the MRC to create the proposed life sciences foundation. This proposal did not, however, receive unanimous support in the scientific community, and it was recognized that the presence of biology within the support programs of the NRC would be advantageous to the encouragement of interdisciplinary science.

90. The granting operations of both the NRC and the MRC are highly regarded in the science community and the Government does

not feel that any redistribution of responsibilities is called for.

91. The terms of reference of the Medical Research Council will remain basically the same.

92. Coordination of the operations of the existing Councils is at present carried out by the Tri-Council Coordinating Committee. This committee is composed of the heads of the three Councils and the Secretary of MOSST and is chaired by the President of one of the Councils. This coordinating mechanism was criticized by the Senate Committee and others as being ineffective, and a number of alternatives have been proposed.

93. The Senators recommended a Canadian Research Board which would advise the Minister responsible for the three foundations on the overall allocation of funds among them and, in addition, would perform the coordinating functions now performed by the Tri-Council Committee. The Board would have a part-time independent chairman and its membership would consist of the heads of the granting agencies and others, including a number of non-government scientists.

94. While the Government agreed that a strong coordinating board or committee was needed, it was recognized that, since its main functions would be of an internal or inter-council nature, the involvement of non-government scientists would be inappropriate. Taking into account the coordinating and advisory role of MOSST, it was felt that the Committee should be chaired by the Secretary of the Ministry and should report to the Minister of State for Science and Technology. It would be composed of the heads of the Granting Councils and the Secretary of MOSST. Other Senior Officials may be asked to participate in the deliberations on occasion, depending on the subject-matter under discussion. The functions of the Inter-Council Coordinating Committee will be:

- a) to ensure coverage of all recognized disciplines;
- b) to ensure that the needs of interdisciplinary research are met;

- c) to harmonize granting practices;
- d) to provide a forum for the discussion of matters of interest to all three Councils.

95. It is emphasized that the Granting Councils will not report to the new Inter-Council Coordinating Committee. Each will report to Parliament through its own Minister. Each Council will have a governing board made up of members selected from the scientific community at large and appointed by the Governor-in-Council. Finally the Councils will continue to use the peer assessment mechanism in the operation of their programs.

F. THE GOVERNMENT'S POSITION REGARDING THE SCIENCE COUNCIL OF CANADA.

96. The Senate Committee has made a number of recommendations relating to the Science Council. They include changing the Council's name to the Science and Engineering Council of Canada, making its chairman and vice-chairman full time, increasing its membership to include social scientists and doing away with the status of associate membership. The Senators were concerned that the present roles of MOSST and the Science Council tended to overlap, and they suggested that, unless MOSST achieved the authoritative budgetary role that they had recommended, the Science Council as a second advisory body should be abolished.

97. The Government is receptive to the Senate Committee's recommendations regarding increased membership and the abolition of associate membership, but is less inclined to accept the change in the Council's title or the appointment of a full time chairman and vice-chairman.

98. There are distinct differences in the roles that MOSST and the Science Council play as advisers and the Government intends to amend the terms of reference of the Science Council in such a way as to emphasize this difference.

99. The Science Council is independent of government direction

and, as well as developing views on science and science policy, plays an important role in educating the public about the impact of science and technology on society. MOSST, on the other hand, is an "in house" advisory body concerned primarily with internal policy development, advice and coordination. The Government intends in its new legislation to emphasize the public role of the Science Council and will expect that in the future the Council will concern itself more with public awareness of science and its implications for society.

G. THE GOVERNMENT'S POSITION REGARDING THE PERFORMANCE OF S&T ACTIVITIES IN FEDERAL DEPARTMENTS AND AGENCIES.

100. The S&T functions implicit in the statutory responsibilities of federal departments and agencies can be grouped under five headings:

1. Science-based Services
2. Regulatory Functions
3. S&T Support of Major Government Functions (e.g. Defence)
4. Support of Basic Research and Overall National Capacity in Science.
5. Support of Canadian Industry.

101. It is under headings (1), (2) and (3) above that the Federal Government actually performs research and other related activities (e.g. scientific data collection, testing, standardization, etc.).

102. The Senate Committee made far-reaching recommendations regarding the performance of research in federal departments and agencies. The "Make or Buy" policy has constituted the Government's response to some of these recommendations, and since this policy has already been referred to and is described in detail in an appendix, it will not be further covered at this point. Recommendations concerned with the Granting Councils have already been referred to in an earlier section. Those concerned with departments and with the NRC laboratories were:

1. that most basic research activities of the Federal Government be concentrated in a National Research Academy,
2. that government laboratories with an industrial orientation be brought together in a new Crown agency.

103. The Committee called for a National Research Academy with three Institutes for the physical sciences, life sciences, and social sciences. The NRC laboratories (separated from the granting function) were to provide the nucleus of the new organization. The future of the NRC laboratories has been debated at great length, both inside and outside government, and the decision has been reached not to make radical changes to its structure or terms of reference, but rather to encourage the agency to make a significant internal shift in emphasis towards support of Canadian industry and contribution to solution of specifically Canadian problems.

104. The recommendation calling for a new Crown agency to incorporate those government laboratories involved in industrially oriented research implied massive and complex organizational and operational issues. The Government is not, however, satisfied that benefits of such a large scale reorganization would justify the disruption and cost imposed. An example of the problems inherent in bringing about such a radical reorganization is the difficulty of deciding what aspects of research and development are separable from the mission of a department without destroying its operational capability. The dividing line between research and other scientific activities such as data gathering is often almost impossible to determine.

105. The Government has noted the Senate Committee's general emphasis on the need for a continuous overview of the scientific activities of departments and agencies, and agrees that such an overview is indeed necessary in order to avoid waste, duplication and lack of relevance to stated objectives. The Ministry of State

for Science and Technology is becoming increasingly equipped to perform this function and Senators may be assured that the Ministry's overall concerns and objectives are very similar to those that the Senate Committee has expressed.

H. OTHER MATTERS OF CONCERN TO MOSST IN WHICH THE SENATE COMMITTEE HAS EXPRESSED A SPECIFIC INTEREST.

The Federal Government's relationship with scientific institutions.

106. Federal support of the activities of Canadian scientific and technical associations is not at present based on clearly defined objectives and guidelines. There is a tendency for departments and agencies to react on an individual basis to the needs and requests of associations. Furthermore, the Federal Government has often had to step in and perform a role that in other countries would be performed by some senior non-governmental agency in fields such as information and representation.

107. The Senate Committee recommended that the Royal Society of Canada and SCITEC become the main spokesmen of the scientific community, and that the Royal Society of Canada become overall coordinator of Canadian S&T representation at the international non-governmental level. These recommendations did not receive the general support of the scientific community and the Government has not acted on them. The Government has, however, decided to channel to the Royal Society of Canada, through the Department of Supply and Services, on an experimental basis, some departmental contracts for science and technology services in response to government needs. The Ministry of State for Science and Technology will be responsible for overseeing the effectiveness of this policy, the aim of which is to provide the RSC with some financial support and the opportunity to contribute to the solution of national problems.

108. The Senate Committee recommended that the name of the

Institute for Research on Public Policy be changed to the Institute for Research on Social Policy, and that its financing and research priorities be approved by a Federal-Provincial Ministerial Committee on Science and Technology.

109. While the Government recognized the need for intensified research on social policy and for avoiding duplication, it nevertheless felt that this recommendation confused a number of different aims. Other possible avenues of cooperation need to be explored before resorting to a Federal-Provincial Committee at Ministerial level, and cooperation should not, in any case, be limited to the social aspects of public policy. The Government feels that the Institute's independence is its strength and should not be weakened by outside constraints.

S&T information.

110. It has been clear for some time that Canada needs a system for storing, retrieving and disseminating S&T information (STI). The Senate Committee placed considerable emphasis on the importance of a strong and coordinated STI organization and made a number of specific recommendations on the subject. The overall thrust of these recommendations was towards the establishment of MOSST as the general focus of STI planning and operations.

111. The Ministry agreed with the importance of STI to Canada but did not accept the proposal that MOSST should itself become the primary agency responsible. The Ministry will certainly maintain an overview of the STI scene, but the prevailing opinion is that STI services have to be established in response to the needs of specific types of customer. Linkages between systems are being encouraged and the NRC is carrying out research on new techniques for storage and retrieval of S&T information. Emphasis will be placed on evolutionary improvements and cooperative use of information resources.

112. This philosophy was embodied in the direction given by the

Cabinet in 1969 that the NRC, under the general direction of the National Librarian, develop, in concert with existing information organizations, a national scientific and technical information system to encompass the natural sciences and engineering.

113. In 1974, the National Science Library and the Technical Information Services of the NRC were merged in the Canada Institute for Scientific and Technical Information.

Futures Research.

114. The Senate Committee made a number of recommendations concerning the study of Futures. They included enlarging the activities of the Economic Council to incorporate a Committee on the Future, sponsoring a conference on anticipatory institutions, and coordinating technological forecasting activities in the Federal Government. The Ministry has agreed with the general intent of these recommendations. The Economic Council is now exploring ways and means of extending the time horizons of its research and policy advisory functions. A leadership role in Canada in futures research has been assumed by the Institute for Research on Public Policy. The Institute will also serve as a catalyst and clearing house for futures studies. The Ministry agreed that some degree of overall coordination of the technological forecasting activities within government is also desirable. The Ministry chairs the ad hoc Interdepartmental Committee on Technological Forecasting which was created in late 1973 in answer to these needs. This committee acts as a focus for futures activities in the Canadian government. Through this committee, presentations on methodology by experienced professional groups, surveys and questionnaires on futures studies, discussions and information on conferences and seminars have been encouraged. The Senate Committee has asked for a separate report on futures studies and MOSST will be responding to this request at a later date.

Appendix "A"

MINISTRY OF STATE FOR SCIENCE AND TECHNOLOGYTOTAL BUDGET 1971-1976

(\$ thousands)

1971-72	1,117
1972-73	2,918
1973-74	5,111
1974-75	4,603
1975-76	4,964

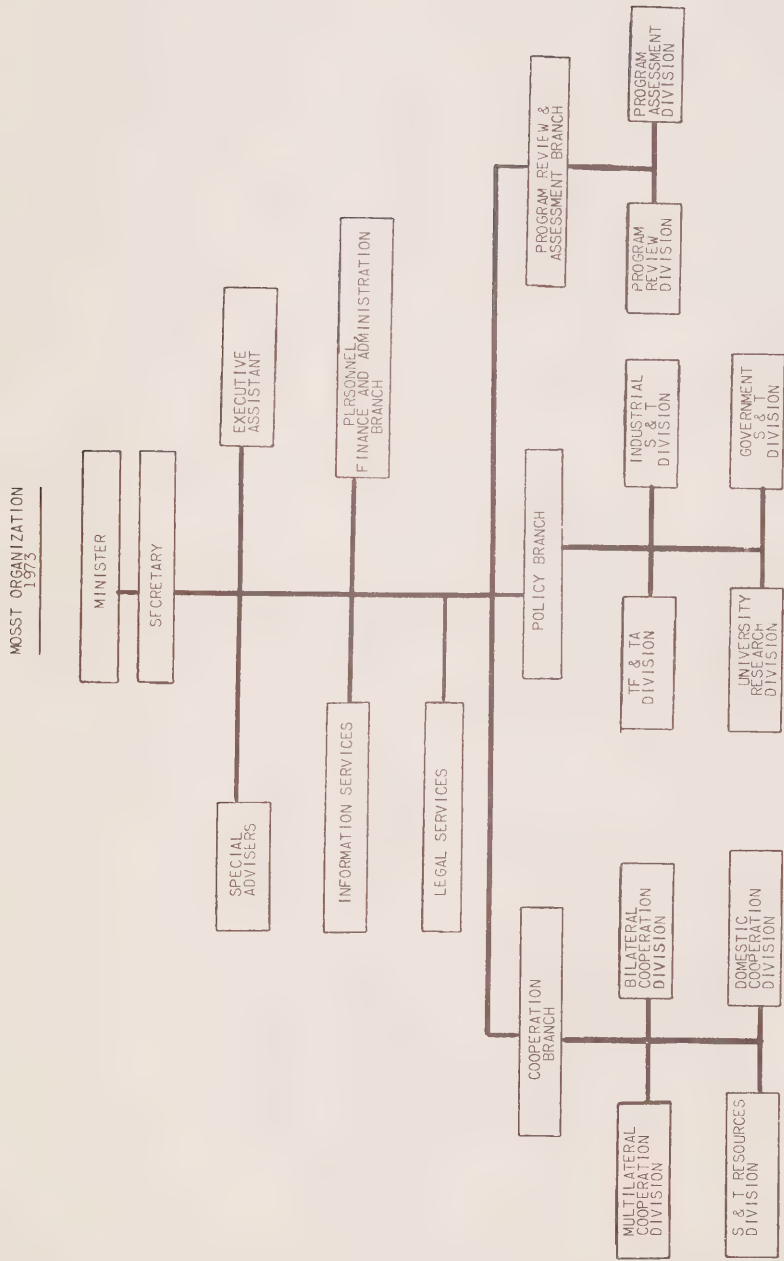
PLANNED CONTINUING EMPLOYEES 1971-1976

March 31, 1972	44 (23) ¹
March 31, 1973	90 (50)
March 31, 1974	112 (63)
March 31, 1975	160 (90)
March 31, 1976	169 (97)

Figures in these tables have been abstracted from the Blue Book for the fiscal year ending March 31, 1976

¹Figures in brackets refer to executive scientific and professional, administrative and foreign services categories.

APPENDIX "B"



Appendix "C"

CASE HISTORIES OF MAJOR SCIENCE POLICY INITIATIVESOCEANS POLICYPolicy Formulation

1. In September, 1972, Cabinet, in response to a memorandum from the Ministers of MOSST and Environment, decided that Canada's ocean policies needed review with particular emphasis on ocean science and technology and the development of ocean industry. Factors critical to this decision were the increased demands on both industry and government for the scientific and technical expertise necessary for management and exploitation of ocean resources coupled with the fact that there existed neither a pervasive policy nor overall guidelines to govern the actions of federal departments and agencies with maritime interests.

2. Responding to the Cabinet directive MOSST, in cooperation with the Privy Council Office, established the Task Force on Ocean Industry, Science and Technology with members from the federal departments and agencies having maritime responsibility. The objectives of the Task Force were:

- (1) To bring to Cabinet's attention the strategic significance to Canada of the ocean and its resources.
- (2) To identify areas of marine science and technology where federal policies are, or will be, inadequate to meet Canada's increasing responsibilities, commitments and opportunities.
- (3) To recommend specific policies for ocean science, technology, and industry which could be implemented immediately.

- (4) To recommend structures and instruments for the formulation, coordination and implementation of Canada's policies for marine science and technology.

3. The Task Force, which was established under the Chairmanship of the Senior ADM of the Department of Energy, Mines and Resources and later the ADM (Ocean and Aquatic Affairs), Department of the Environment, had representation at the level of Director or above from all departments and agencies concerned in any major way with ocean matters. The day-to-day operations of the Task Force were delegated to a small working group to which MOSST provided a senior officer on a full-time basis.

4. The Task Force conducted a detailed study of five principal areas of concern relating to the oceans:

- (1) Management of sub-ocean mineral and petroleum resources
- (2) Management and protection of ocean biological resources
- (3) Oceans as a medium for transport
- (4) Oceans in relation to defence and security
- (5) Measurement and maintenance of oceans quality.

These studies were reviewed individually by the interested departments and then combined to form a single report. This report stressed that Canada must develop and control, within areas under Canadian jurisdiction, the essential capacity to locate, manage, and exploit off-shore resources. To this end, it was urged that a policy be adopted which

would, inter alia, stimulate the development of Canadian ocean industry and ensure that Canada possesses an adequate level of scientific and engineering expertise and knowledge to permit rational management and exploitation of our ocean resources. The government approved the policy on July 12, 1973.

Policy Implementation

5. The provisions of the policy and actions which have been taken towards their achievement are summarized as follows:

- (1) MOSST and other concerned departments and agencies should ensure that Canada develop, within five years, an internationally recognized excellence in operating on and below ice-covered waters.

6. In response to this provision, an ad hoc interdepartmental advisory committee was established by the Minister of State for Science and Technology in November 1973 to discuss the requisite operating capabilities. At the same time, MOSST retained a consultant to assist in the identification of program requirements. After extensive consultation involving a broad survey of industrial and government expert opinion, a series of R&D programs were identified in September, 1974, as critical to development of the ice-covered waters operating capabilities. Further extensive interdepartmental discussion resulted in the determination of relative priority ratings for the various proposed programs and the preparation for Cabinet consideration of proposals designed to achieve Canadian

ice-covered waters operating expertise.

- (2) The Minister of Industry, Trade and Commerce, in consultation with the Ministers of other concerned departments and agencies should bring forward proposals for the development and support of Canadian ocean industry.

7. In response to this directive, the Department of Industry, Trade and Commerce has developed proposals to encourage greater research and development of ocean technology in Canada, efficient production of ocean related products, development of internationally competitive service contractors, higher degree of Canadian ownership and control, regional expansion of industrial activities, and an increased level of professional and technical personnel with ocean related capabilities.

8. Of further relevance to the Ocean Policy provisions in support of ocean industry has been the establishment by the Department of Indian and Northern Affairs of the Advisory Committee on Canadian Content in Oil and Gas Operations on Canada Lands, recently given a broader mandate and renamed the Advisory Committee on Industrial Benefits from Natural Resource Development. This sub-committee of the Advisory Committee on Northern Development was established in March 1974, in light of concerns expressed by MOSST, that Canadian ocean industry was not being given adequate opportunity to participate in northern resource development projects. Since its inception, the Advisory Committee has been instru-

mental in bringing about an increased Canadian content in certain of these projects. The government's intention to promote increased sourcing in Canada of equipment and services used in resource exploitation projects has recently been stressed by the Minister of Indian and Northern Affairs.

- (3) Special emphasis should be given to national marine science and technology programs which support various oceans related objectives such as the development and management of Canada's ocean resources, the management of estuarian, coastal and nearshore zones and improved capabilities to predict marine atmospheric and oceanic factors (weather, sea state, currents, ice, etc.)

9. The Ocean Resource Management Program of DOE represents one response to this directive. This is a major 6-year scientific program to carry out the scientific research necessary for sound resource management in two of Canada's most crucial coastal areas: the Strait of Georgia and the Gulf of St. Lawrence. The significance of this program goes beyond research per se. In both of the study areas there are a multiplicity of interests, often overlapping and sometimes competing, originating in both the private and government sectors, all legitimately concerned regarding the management of the ocean resources in the region. In order that all the potential "customers" for the research results stemming from the Ocean Resource Management Program could participate in the overall planning and design of the research, MOSST proposed that Program Requirements Boards be established for both the Strait of Georgia and Gulf of St. Lawrence sub-programs.

These Boards are made up of representatives from the federal and provincial governments, private industry, public utilities and the universities. The purpose of the Boards is to review proposed research to ensure that it does, in fact, support the management objectives of the ocean resources as viewed from the perspectives of the various "customers". MOSST is represented on these Requirements Boards.

10. The Beaufort Sea Project is a further illustration of a response to this directive. Conducted as a joint undertaking by the government and the Arctic Petroleum Operators Association, this concerted scientific program is aimed at establishing a sufficiently sound scientific understanding of the Beaufort Sea environment to allow safe oil and gas operations. The program constitutes a total environmental approach and includes detailed investigation of wildlife, fish, oceanographic and geological parameters, and the interaction between oil, ice, and sea water. It is anticipated that the program will result in significant improvement in the government's ice and weather forecasting capabilities in the area and will lead to a marked upgrading of the abilities of both government and industry with regard to the detection, containment and clean-up of oilspills in ice-infested waters.

11. Numerous other activities, both ongoing and planned, can be considered as responding to the directive to develop marine science and technology in support of broad national objectives. Among these are included the ice-covered waters proposals, the Ministry of Transport's decision to assist in construction and operation of an ice-breaking bulk carrier,

and a proposed 18 million dollar expansion of the Bedford Institute of Oceanography.

Policy Evaluation

12. The Cabinet decision of July 12, 1973, assigned responsibility for evaluation of the Oceans Policy and its implementation to two agencies, the Canadian Committee on Oceanography and MOSST.

13. The Canadian Committee on Oceanography (CCO) is an association of universities, industries and federal government agencies that are directly involved in marine research and its applications. Because of its multisectoral perspective, the CCO was directed by Cabinet to advise the government on the general state of Canada's ocean science and technology, on possible opportunities for participation of Canadian industry in oceans-related programs and on opportunities for new Canadian initiatives in the development and use of ocean science and technology.

14. The CCO has reviewed and commented upon the proposed program for ice-covered waters operating excellence and, through its various subcommittees, has been involved in review of the Ocean Resource Management Program proposals from the early stages. With regard to international concerns, the CCO is the interface agency through which Canadian participation in a growing number of joint multilateral oceanographic undertakings is being co-ordinated.

15. MOSST's position with regard to evaluation of the Oceans Policy is one of overview and catalysis. The Cabinet

directed that MOSST conduct a continuing review of policy on ocean industry, science and technology and, in consultation with concerned departments, develop appropriate policies and guidelines as needs arise.

16. In order to keep informed, MOSST is represented at meetings of the CCO, on the various committees and boards which have already been mentioned as having been established to ensure effective implementation of various Oceans Policy provisions, and on various other oceans-related groups, such as the Interdepartmental Committee on the Law of the Sea. Moreover, MOSST receives information on programs through its budgetary review process in association with the Treasury Board Secretariat.

"MAKE OR BUY"Policy Formulation

17. Briefs and letters to Ministers and reports from outside government on the subject of the decline of industrial R&D in Canada during the early 1970's led, in 1971, to consideration of the use of the Government's procurement in science and technology fields as a means of enhancing the country's industrial technology base.

18. Although the "Make or Buy" approach for handling such requirements had been considered several years earlier, it was proposed to give it a more positive definition based on current conditions. The objective of the policy is to increase the usefulness of government science by having industry and other non-government performers carry out the necessary science and technology, thereby, enhancing the level of industrial technological capability in Canada.

19. All interested departments and agencies were consulted during the preparation of three Cabinet Memoranda which defined the principles of the policy, the criteria governing which scientific activities would be contracted out, and the restrictions and limitations for initial implementation. The Memoranda were prepared during the first half of 1972. MOSST prepared the first two and acted as the focus for the associated interdepartmental discussions. The third Memorandum was prepared by DSS with a major input by MOSST.

Policy Implementation

20. The policy embraced research, development and feasibility

studies in the natural sciences with the preferred performer being industry. While other performers from the universities and non-profit institutions were not covered by this policy, there has been no change in the practice of placing R&D contracts with them whenever it is the most effective way to do so.

21. The policy was announced in August 1972 and implemented in early 1973. Implementation was based on the premise that the onus should be on the departments and agencies, to show why new mission-oriented research and development could or should not be conducted in industry. The criteria for permitting "in-house" R&D were:

1. Where questions of security prohibit industrial involvement;
2. Where the R&D required is inappropriate to industry or a suitable industrial capability does not exist and it would not be of benefit to Canada to create one;
3. Where the R&D is essential to a regulatory function and no private establishment independent of the firms being regulated can be found or created;
4. Where the R&D is essential to the development and maintenance of a set of national primary standards and of certain secondary and consumer standards;
5. Where conduct of the R&D is essential to establish and maintain the requisite level of expertise within Government; and

6. Where the conduct of R&D is necessary to the effective support and operation of intramural capital facilities which provide central testing and research services which are agreed to be necessary to Canadian industry.

22. The Department of Supply and Services was assigned the central contracting responsibility under the policy. However, the policy did not create special funding and requirements for mission-oriented R&D have been funded through normal budgetary mechanisms and procedures.

23. To date, contracts with industry for R&D and feasibility studies under the Make or Buy policy have totalled \$72 million. Various funded programs (e.g. those of the Canada Committee on Agricultural Engineering and the Canada Committee on Meats) have been established in accordance with the policy. In addition, policies for Space and the Oceans, prepared since the Make or Buy policy came into effect, have incorporated the principles of that policy.

Policy Evaluation

24. MOSST is undertaking an evaluation of the policy for the period 1973-1975. Preliminary results of this evaluation indicate that the results have been in accordance with the policy objectives, but that only a few industry sectors have been reached by the policy.

UNSOLICITED PROPOSALS PROGRAM

(An Adjunct to Make or Buy)

Policy Formulation

25. The increasing involvement of the industrial sector in the Government's requirements of science and technology as a result of the Make or Buy policy has led to a large number of unsolicited research proposals from the private sector. A mechanism to handle such proposals was developed as an adjunct to the Make or Buy policy and was thus the initial phase in extending its scope.

26. The objective of this adjunct is to permit Government departments and agencies to take advantage of good ideas from outside Government.

27. The policy adjunct was defined in two Memoranda to Cabinet: the first identified the principle of the policy, and the second the mechanism for its implementation including the establishment of a fund to provide bridge financing to support accepted proposals until the sponsoring department could incorporate on-going work arising from the proposals into its budget.

28. All interested departments and agencies were consulted during the development of the policy. MOSST prepared both Cabinet Memoranda. The first received approval in July, 1973 and the second in February, 1974. For preparation of the second Memorandum, a senior officer from the Department of Industry, Trade and Commerce was seconded to the Ministry.

Policy Implementation

29. The Department of Supply and Services was given the

central role in administering the policy adjunct and the associated Fund. The policy was implemented in June 1974, when establishment of the Fund was approved in the Main Estimates of the Department of Supply and Services. An announcement was then circulated to all departments and agencies and to the public shortly thereafter.

30. The principal criteria established for acceptance of unsolicited proposals from Canadian sources are that the work to be undertaken is within the mission and priorities of the sponsoring department and that the proposal is sufficiently unique to warrant a non-competitive contract.

31. Funding for FY 1974/75 was designated at \$3 million, which was increased to \$10 million for FY 1975/76. Since implementation of this policy, 130 contracts with a total value of \$12.7 million have been placed as of September 15, 1975.

32. MOSST has participated on a continuing basis in the interdepartmental evaluation of each unsolicited proposal to assess the relevance and priority of the work to be performed within the overall program of scientific activities of the sponsoring department.

Policy Evaluation

33. DSS has provided monthly reports on the status of the Unsolicited Proposals program and has reviewed the results of the initial 16 contracts which have been completed. This initial evaluation indicates that the results of the initial contracts have been of commercial and technological significance while contributing to the science mission of the

sponsoring departments. A good example of this dual achievement would be the \$375,000 contract to Hunttec-70 Ltd. for the development of a new seismic system to map the geology of the ocean floor. Not only was the project a success technically, it also contributed to the science mission of the Bedford Institute of Oceanography and gave further strength to the scientific and technological capabilities of the company.

SPACE POLICYPolicy Formulation

34. Canadian space activities, which date back to the 1950's, have included satellites for research, technology development and operational purposes and have involved significant bilateral and multilateral cooperation with other nations and agencies. Canada's primary interest in space is to use it for applications that contribute directly to the achievement of established national goals.

35. The development of a definitive space policy began in the early 1970's with the establishment of an Interdepartmental Committee on Space. This committee, which had membership from those departments and agencies with responsibilities or interests in space science, reported to a Cabinet Committee.

36. Almost from its inception the committee found itself involved in the issue of Canada's possible participation in the U.S. Space Shuttle Program. The complexity of this issue tended to overshadow the more **general** but nevertheless pressing problem of establishing a national space policy. Lack of such a policy, in turn, made it difficult to reach a decision regarding the shuttle program.

37. When the Ministry of State for Science and Technology was formed the secretarial responsibilities for the Interdepartmental Committee on Space (ICS) were accepted by the Ministry as part of its inheritance from the Science Secretariat. The Ministry considered the development of a space policy to be an important matter and, through its membership

on the ICS initiated studies and discussions that led up to the presentation to Cabinet in April 1974, by the Minister of State for Science and Technology of a proposed Canadian Policy for Space. This policy, which was accepted by Cabinet was based on the principle that, to make effective use of space application systems, Canada requires:

- (a) appropriate knowledge of space
science and technology
- (b) the ability to acquire and operate
effective and economic space systems; and
- (c) the ability to have space hardware (e.g.
satellites) launched when required.

38. The policy emphasized the need for Canada to take part in international space activities, to build up the capabilities of Canadian industry and, in particular, to aim towards a high level of Canadian content in the design, construction and program management of satellite systems. It was agreed that Canada will continue to rely on purchasing foreign launch vehicles and launching services for her satellites but will enhance access to such services by participating in the supplying nation's space program.

Policy Implementation

39. The Interdepartmental Committee on Space has the responsibility for coordinating the government's space effort. The government has been pursuing procurement policies and procedures aimed at progressively increasing the Canadian content in our satellite systems. The government's

objective has been to create areas of specialization in Canadian space industry and to develop a vertical integration of activities from research through to the marketing of space products in those areas. Examples include the remote manipulator system for the U.S. space shuttle program which was developed and will be supplied by a consortium of Canadian companies headed by SPAR Aerospace; major subsystems of the Communications Technology Satellite have been designed and built in Canada as have certain subsystems for U.S. spacecraft; further, a Canadian company, MacDonald, Dettwiler and Associates, has developed with government assistance a portable ERTS station to acquire data from earth resource satellites. The station will be used in Canada and is being successfully marketed in other countries.

Policy Evaluation

40. The Ministry, through the ICS, will continue to maintain a general overview of space activities, assess the results of the new space policy and, when appropriate, advise the government on any needed changes.

ENERGY RESEARCH AND DEVELOPMENT POLICYPolicy Formulation

41. The focus for the development of this policy has been the Department of Energy, Mines and Resources. MOSST has played a supporting role.

42. On 15 January, 1974, the Cabinet accepted a proposal put forward by the Minister of Energy, Mines and Resources that a Task Force be established to review, develop and implement a coordinated federal program on Energy R&D.

43. The Task Force which reported to the Minister of EMR was composed of Deputy Ministers or senior officials of sixteen departments and agencies having responsibilities or interest in energy matters and was chaired by the Deputy Minister of EMR.

44. The objectives of the Task Force were to:

- 1) review federal energy R&D activities;
- 2) develop and implement a coordinated federal program on energy R&D;
- 3) advise Treasury Board on the allocation of funds for energy R&D;
- 4) coordinate energy research and development activities in the federal government, including the federal approach to major international and federal-provincial initiatives;
- 5) provide for the exchange of information on energy policy and strategies which would affect the direction of federal energy research and development programs.

45. The work of the Task Force was divided between a number of working groups each of which was allotted a specific area of the subject for study. MOSST accepted the responsibility for organizing the preparation of a working paper on the various forms of financial incentive available to the Government for the encouragement and support of Energy R&D.

46. In April 1975, the Task Force reported to the Cabinet recommending a number of Energy R&D programs that it considered should be initiated on a high priority basis. It also recommended an ongoing structure to develop and implement these programs. The Cabinet accepted the recommendations in principle but called on the Task Force to make a further study and come forward with a proposal for allocating relative priorities to the programs.

47. Work on developing these priorities has continued and recommendations will be presented to Cabinet in the near future.

Policy Implementation

48. The policy will be implemented by an organizational structure made up of:

- (a) The Task Force on Energy R&D;
- (b) A Panel on Energy R&D reporting to the Minister of EMR, composed of senior representatives from federal lead departments and MOSST;
- (c) The Office of Energy R&D in EMR;
- (d) Lead departments and agencies identified in the Task Force Report as being appropriate to each program;

Policy Evaluation

49. The responsibility for reviewing and evaluating the policy will rest with the Minister of Energy, Mines and Resources.

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REPORT

FIRST SESSION—THIRTIETH PARLIAMENT

1974-75

GOV

Parliament

THE SENATE OF CANADA

PROCEEDINGS OF THE

STANDING SENATE COMMITTEE ON

SCIENCE POLICY

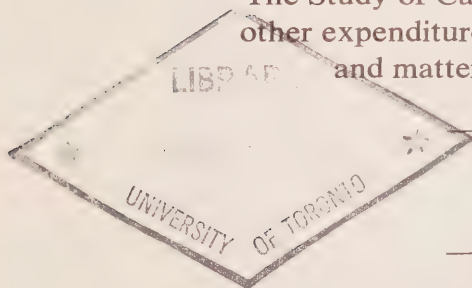
The Honourable MAURICE LAMONTAGNE, P.C., *Chairman*

Issue No. 2

TUESDAY, DECEMBER 16, 1975

Second Proceedings on

The Study of Canadian Government and
other expenditures on scientific activities
and matters related thereto.



(Witnesses and appendices: See Minutes of Proceedings)

THE SPECIAL COMMITTEE OF THE
SENATE ON SCIENCE POLICY

The Honourable Maurice Lamontagne, P.C., *Chairman*

The Honourable Donald Cameron, *Deputy Chairman*

and

The Honourable Senators:

Asselin	Hastings
Bélisle	Hicks
Bell	Lang
Blois	Manning
Bonnell	Neiman
Bourget	Riel
Buckwold	Robichaud
Carter	Rowe
Giguère	Stanbury
Godfrey	Thompson
Goldenburg	van Roggen
Grosart	Yuzyk
Haig	

27 Members

(Quorum 5)

Order of Reference

Extract from the First Report of the Special Committee of the Senate on Science Policy, presented on July 10, 1975 and printed as an Appendix to the Minutes of the Proceedings of the Senate of that day, and adopted by the Senate on July 24, 1975:

"The Committee, therefore, recommends that it be authorized to consider and report on Canadian government and other expenditures on scientific activities and matters related thereto;

That the Committee have power to engage the services of such counsel and clerical personnel as may be necessary for the purpose of the inquiry;

That the Committee have power to send for persons, papers and records, to sit during adjournments of the Senate and to report from time to time; and

That the Committee be authorized to print such papers and evidence from day to day as may be ordered by the Committee."

Robert Fortier,
Clerk of the Senate.

Minutes of Proceedings

Tuesday, December 16, 1975
(11)

Pursuant to adjournment and notice, the Special Committee of the Senate on Science Policy met this day at 9:00 a.m., the Chairman, the Honourable Senator Lamontagne, presiding.

Present: The Honourable Senators Bonnell, Cameron, Carter, Godfrey, Grosart, Lamontagne and Lang. (7)

In attendance: Messrs. Philip J. Pocok, Director of Research, and Jacques W. Ostiguy, Chief of Administration.

The Committee resumed consideration of its Order of Reference dated July 24, 1975 relating to the study of Canadian Government and other expenditures on scientific activities and matters related thereto.

The Chairman made an opening statement.

The following witnesses were heard:

The Honourable C. M. Drury,
Minister of State for Science and Technology;

Dr. M. J. LeClair,
Secretary to the Ministry of State for Science and Technology;

Mr. D. H. E. Cross,
General Director,
Program Review and Assessment Division,
Government Branch,
Ministry of State for Science and Technology.

During the course of his introductory remarks, Mr. Drury tabled five documents entitled: "The Granting Research Councils", "The Role of the NRC in Canadian Science and Engineering: A Redefined Policy Framework", "Trends in Science and Expenditures", "Distribution of National R&D Expenditures by Sectors of Performance and Country, 1967-1971" and "Comparison of Federal Government Costs for Science, R&D, and Mission-Oriented R&D". The Committee *Agreed* to print these documents as appendices to this day's Minutes of Proceedings. They are printed as Appendices "9 to 13", respectively.

At 11:00 a.m., the Committee adjourned to the call of the Chair.

ATTEST:

Patrick J. Savoie,
Clerk of the Committee.

The Standing Senate Committee on Science Policy

Evidence

Ottawa, Tuesday, December 16, 1975.

The Special Committee of the Senate on Science Policy met this day at 9 a.m. to consider Canadian Government and other expenditures on scientific activities and matters relating thereto.

Senator Maurice Lamontagne (*Chairman*) in the Chair.

The Chairman: Honourable senators, although the minister cannot remain more than an hour this morning, I should like to make a statement of about ten minutes' duration, which I hope will help us later to gain time and make more rapid progress.

During our first public hearing, held on December 3, we had a wide-ranging and at times confusing discussion. That was to be expected at the beginning of a dialogue on complex issues. I would hope, however, that from now on our discussion will be more specific and positive because the time at our disposal is rather limited.

After our first meeting I once again read sections B and C of the brief, and I had the feeling that they had not been prepared by the same author. Section B partly contradicts section C and contains several misrepresentations about our committee's views and recommendations. For these reasons, but also because it had often been reproduced before, more or less textually, in public speeches by the minister and his officials, section B should probably have been left out of the brief.

However, it has been included and the misrepresentations it contains concerning the committee's report have already been and could again be the cause of a sterile dialogue. Although those misrepresentations were likely unintended, I believe that they should be corrected once and for all so that we can proceed with our work in a climate of better mutual understanding. I now propose to do this as objectively and as briefly as possible.

1. In paragraph 18 it is stated that some authorities had insisted that "science policy should be a single indivisible entity," that the ministry found this concept unworkable and that "there is nothing in the Senate committee's report to indicate that the committee espoused it." It would have been closer to the truth to say that we strongly rejected that view espoused by the supporters of what we described in volume 1 of our report as the Republic of Science and the Republic of Management. We insisted on the distinction between policy for science and science for policy in much the same way as MOSST does. Thus, there is much more basic and substantial agreement between us on this issue than the brief would lead us to believe. The fact that science policy, like many other policies such as trade and fiscal policies, is divisible and may have three or more distinct areas should not lead us to conclude that there is no such thing as a science policy.

2. In paragraphs 20 and 21, it is stated that the committee recommended that MOSST should have budgetary authority over science expenditures. As Senator Grosart has pointed out, we never made such a recommendation. We proposed that the ministry, in addition to its other responsibilities, should be asked to review and assess proposed science expenditures before their approval. In paragraphs 23, 24 and 25, and later on in the subsection of the brief entitled "MOSST's responsibilities in relation to budgetary matters," the ministry describes the new role assigned to it in January, 1974, in almost exactly the same terms as we had proposed it in our volume 3 published in September, 1973. In paragraph 39, for instance, it is stated that "procedures have been established for the review and assessment by MOSST of proposed science expenditures." Thus, the tactic used in some parts of the brief seems to be to present a straw man by attributing to the committee a proposal it did not make, then to destroy this straw man and describe the new reality which is usually in close conformity with what the committee had recommended. This tactic is confusing, to say the least, and is certainly not conducive to an orderly discussion.

3. The brief creates another useless confusion in relation to the budgetary procedure regarding proposed science expenditures. Senator Grosart referred to it during our first hearing. The committee, in volume 3 of its report, had recommended the establishment of a science budget whereby estimates related to scientific activities would be submitted to a special and separate review and assessment procedure before being approved.

The brief states in paragraph 22 that "a science budget in the conventional sense (i.e. as a basis for resource allocation) cannot reasonably be accommodated in the existing structure and procedure of the Government." But in paragraph 23 it asserts that "The Government can, however, through the Ministry of State for Science and Technology, ensure that plans and budgets for scientific activities are screened by competent analysts... and that advice by the Ministry is effectively introduced into the decision-making process." I submit that this is exactly what the committee had in mind when it recommended the establishment of a science budget.

Subsequently, the brief goes on to describe in detail four steps that the new budgetary procedure involves. First, as indicated in paragraph 42, it calls for "the separate preparation of data in connection with science expenditure proposals" by departments, including "detailed information on current and proposed scientific expenditures." This corresponds exactly to the first step proposed by the committee at pages 656 and 657 of volume 3 where we said:

Departments and agencies would continue to prepare their budgetary proposals as they do now, except that they would separate their scientific activities from their operational programs.

Secondly, according to paragraph 44 of the brief, "overall trends, as indicated by the science expenditure data as well as individual request for new activities were reviewed (MOSST) in the context of government priorities and objectives." Paragraph 46 indicated that "Treasury Board strongly supports this MOSST role and TBS has advised departments, who have not done so, to consult MOSST before putting forward submissions." Paragraph 47 states that "In providing advice to TBS on the program forecast, the Ministry has been on the lookout for duplication of effort, lack of adequate interdepartmental coordination, research not related to departmental mandates, and non-uniformities in the planning, budgeting and management of S & T activities." This second step corresponds exactly to what the committee recommended at page 657 of volume 3, where it states:

The science budget or the estimates related to scientific activities prepared by departments and agencies would be submitted to the Ministry of State for Science and Technology for review and assessment, instead of being presented to the staff of Treasury Board. For the government as a whole and for Treasury Board in particular, this procedure would represent a significant improvement over the present situation. Supervision by an impartial group of science policy advisers would offer a better guarantee that waste and undesirable duplication were minimized and that new opportunities were not missed.

Thirdly, the brief makes clear that MOSST's recommendations go to Treasury Board which retains full authority to approve proposed science expenditures. The committee had proposed that such authority be shared with a new cabinet committee for science and technology. We still believe that our proposal had distinct merits, but we accept the government decision, at least for the time being.

Finally, as the brief says in paragraph 39, "Highlights of the approved science estimates are published separately in 'How Your Tax Dollar is Spent'." Thus, the brief claims in paragraph 44 that "science budgetary information was, for the first time (in 1975-76), made available with Main Estimates data."

This last step of the new procedure corresponds to what the committee recommended when it said, at page 658 of volume 3:

The approved estimates of departments and agencies consolidated in the overall science budget would be published separately, as is now done in some countries. This would give Parliament and the public a better idea than they now have of the size and distribution of the government's scientific activities.

Thus the government now has, for all practical purposes, a science budget, and it has adopted for its preparation substantially the same procedure as that recommended by the committee. During our first meeting on December 3, the Minister of State for Science and Technology reluctantly recognized, under questioning by Senator Grosart, the existence, for all practical purposes, again, of such a science budget. It would have been less time-consuming and, I believe, less confusing, if the brief had clearly recognized this new development, instead of stating that such a budget could not "reasonably be accommodated in the structure and procedure of the government."

4. This is the last item I wish to underline this morning. In paragraph 26, the brief gives the impression that the committee, quite impractically, recommended a "fixed-

GNP-related target for the input represented by science." It is true that we suggested that "national expenditure on R & D should reach 2.5 per cent by 1980", but, to us, this was not a fixed but a moving target, to be attained over a period of about a decade. Moreover, we added in our recommendation: "It being understood that the Canadian government's direct contribution to reaching this target will be restricted to the support of worthwhile programs and projects." This very important restriction cannot be interpreted, in my view, as proposing fixed targets. If the author of the brief had carefully read the interpretation given by the committee to its recommendation on pages 422 and 423 of volume 2, he would not have reached the conclusion that the objectives we proposed were fixed. While the brief gives the impression that targets are not meaningful, in the same paragraph it states the "MOSST has fully supported the idea of forward planning" which was put forward by our committee. I find difficult to reconcile these two attitudes, because to me, and to most other people, I think, planning means precisely to set objectives, goals, targets and strategies. In fact the minister himself, during our first meeting, agreed that ideally the relative share of R & D performed by Canadian Industry should be slightly less than that of the private sector in other advanced countries because of our proximity to the United States. To me this is a target, and by a strange coincidence it is quite similar to the 60 per cent recommended by the committee in volume 2.

I hope that this statement will help clear up the confusion and correct the misrepresentations about the committee's views contained in section B of the brief. I would therefore suggest that from now on we forget about this part of the presentation and that today we concentrate on the first two subsections of section C, dealing with MOSST's role, more particularly in relation to budgetary matters.

Since the substance of our proposals regarding this special budgetary procedure for science expenditures has been accepted by the government, I believe that we should concentrate on how this new procedure works in practice.

I thank my colleagues for their patience in allowing me to make this statement, and I hope it will clear up a few matters, so that we will this morning be able to pursue our dialogue with the minister in a less confusing climate than at our first meeting.

I do not know if the minister wants to add something. He certainly has a right of rebuttal. If not, I will ask senators if they have any questions to raise in relation to that part of the brief.

I think that from now on, in order to save time and to be more systematic, we should proceed more or less section by section through the brief.

The Honourable C. M. Drury, Minister of State for Science and Technology: Well, Mr. Chairman, I am delighted that in spite of my obtuseness, and my appearance as a reluctant dragon, you have succeeded in establishing that the minister and the committee are in complete agreement...

The Chairman: I would not say "complete", but "substantial".

Hon. Mr. Drury: —and that any disagreements are illusory.

I undertook last time to seek and put together some more figures, which I will table with the committee this morn-

ing, rather than make the mistake of trying to explain them, as this seems to lead to confusion.

We are fortunate in that this morning we have Dr. LeClair and his able assistant, Mr. Dewar, here, and perhaps the committee can get more light than heat out of these two gentlemen.

I would like, with your permission, to say that I am glad to discover that the brief and the views of the committee are in substantial agreement, in spite of some seeming confusion introduced at the last meeting. I myself, as my opening remarks indicated, am very appreciative indeed of the reports of this committee. I did say that we were in substantial agreement with them, and, indeed, that we had adopted a great many, of the recommendations. I would agree with your formula for passing over this now, as a minor incident in the work of the committee, so that we can get on to something that is perhaps more constructive.

I would like to table with the committee some short papers, of which I have an index. The first item is on the granting research councils, their goals, objectives and functions.

The Chairman: Is this in addition to what is already in the brief?

Hon. Mr. Drury: Yes. Next is a paper on the role of the National Research Council in Canadian science and engineering, a redefined policy framework, which has been worked out by the National Research Council. The third item is on trends in science expenditures, relating to the general conclusions reached by the committee and shared by us, that as a percentage of either gross national products or the national budget, research and development expenditures had been declining in the past three years. The fourth item is on the distribution of national research and development expenditures by sector of performance and country, 1967 and 1971. Finally we have a comparison of federal government costs for science, research and development, and mission-oriented research and development.

I do not have copies for all the members of the committee, so perhaps these might go into the record so that they can be made available in that way. It appears that we do have copies made, but rather than try and deal with them now, I think it might be useful to let the committee have a look at them first.

The Chairman: What are the views of the members of the committee? Should we have those figures printed as an appendix to these proceedings?

Hon. Senators: Agreed.

(For text of tables, see Appendices pp. 20-48).

The Chairman: We still have about 40 minutes. Do any members of the committee have questions as to the actual working of these special budgetary procedures? I would hope that we could deal with this this morning, so that in future meetings we can turn to something else.

Senator Carter: Mr. Chairman, at the last meeting I think we all had a round of questions except yourself. I do not think you should deprive yourself of the opportunity to ask questions. I propose that you start the questioning today.

The Chairman: Very well. My first question, which I am sure is in the minds of all members of the committee here

this morning, is to ask the minister to describe to us in as much detail as possible this kind of budgetary procedure.

How does it work in practice? How does it work in terms of the way the departments and agencies present their proposed science expenditures, the way they are submitted to MOSST, the way they are reviewed and assessed by MOSST in conjunction with Treasury Board, and then the way they are finally dealt with by Treasury Board? I think this is more or less at the centre of what we were trying to get at at the last meeting.

Hon. Mr. Drury: Mr. Chairman, I might suggest that if the committee agrees, rather than my trying to explain this I might ask Mr. Dalton Cross, of the ministry, who is the man directly engaged and directly responsible for the supervision of this process, if he would like to lead the committee through it.

Mr. D. H. E. Cross, General Director, Program Review and Assessment Division, Ministry of State for Science and Technology: Mr. Chairman, the description we have here in the brief is fairly complete. I can either try to respond to particular questions that are asked in relation to the outline here or go into detailed description myself, whichever you would prefer.

The Chairman: I would like you to describe the procedure and how it works in practice. For example, when a program forecast is prepared and the main estimates submitted, how do you get the science proposals from the departments and agencies, how do you deal with them, and how does Treasury Board deal with them?

Senator Grosart: Perhaps Mr. Cross might fit it into the calendar described in "How Your Tax Dollar Is Spent". This is a calendar of exactly when the departments bring in their estimates.

Mr. Cross: Each year, in January, the Treasury Board Secretariat issues a call for program forecasts in which they ask the departments to submit their budgetary proposals. There is attached to that call letter what is called a science addendum, and this requests particular budgetary information with respect to the A base—that is, the ongoing activities of departments—as well as the B budget proposals. This information is submitted to the secretariat along with the program forecast. A copy of the science addendum is peeled off from the information submitted to the board and sent directly to MOSST. We examine this information and try to build up an overview of the trends in science expenditures and the effects that the B budget proposals—that is, the new items that the departments wish to pursue—will have on these trends. We also have access to the program forecasts themselves.

Senator Grosart: What about non-budgetary items?

Mr. Cross: What do you mean by that?

Senator Grosart: Well, there are non-budgetary items in the estimates, and I just wondered if they were included in the addendum request.

Mr. Cross: The addendum covers current and capital expenditure proposals in departments.

Hon. Mr. Drury: I think this is a sort of technical distinction. For instance, the expenditure made on a loan basis by AECL are classified as non-budgetary and these are included in the total.

Mr. Cross: It includes only budgetary estimates.

Senator Grosart: Well, you have statutory items, items to be voted, and non-budgetary items. There are three distinctions made in the estimates and they are important.

Mr. Cross: The MOSST analysts take the information contained in the program forecasts concerning the B budget proposals of the departments, examine it in the context of the trends illustrated by the science expenditure data and form views of the relevance of these proposals to the department's mission, the government's priorities, and to the science policy objectives as have been expressed by certain policies set out by MOSST with the assistance of departments, such as the "make or buy" policy. Having formed these views our analysts sit down with their opposite numbers in Treasury Board, that is the analysts of each organizational element of the Secretariat. They discuss the B budget proposals with the analysts and attempt to arrive at an agreement. During this process MOSST analysts also interact both with our own management and our own minister in a series of briefings held in the period from the end of May into June.

Having reached agreement with the analysts on most items, we then prepare briefings for the heads of directorates in Treasury Board, that is the Director of the groups of analysts in each of the major organizational elements of the Secretariat. So we have an interaction at the analyst level and at the level of each Treasury Board directorate. The directors in turn make recommendations to their superiors, to their deputy secretary, while we on our side make recommendations to our own management trying to resolve differences. Where we cannot come to agreement at the analyst level, there are interactions between the two organizations at the Director level, at the Deputy Secretary level and at the Secretary level itself. Unresolved issues may be carried on to the Treasury Board level through our advice to our own minister.

The Chairman: I understand, Mr. Minister, you are a member of Treasury Board.

Hon. Mr. Drury: That is right.

Mr. Cross: This process continues on during the course of the year into July and August, to the time when individual ministers may be making appeals to Treasury Board itself and subsequently on into the preparation of the main estimates. The cycle is completed with the call for main estimates which departments are expected to have submitted by December 1st. We are also involved in discussions with board analysts on changes which may be occurring at the last minute.

That essentially closes the cycle for program forecasts through to the main estimates. During the course of the year we also interact both with the departments and the board itself on individual submissions both for requests for supplementary estimates and for program approval. We will work with officials of the departments in trying to develop good submissions, submissions that are responsive to the government's priorities and are consonant with such science policies as have been established, and we will give separate advice thereon to Treasury Board officials. We see all Treasury Board submissions which have a science content and normally have an opportunity to influence their content at the departmental level as well as giving advice to Treasury Board officials themselves.

I think that is a fairly concise but complete description of our interaction.

Senator Carter: This is a whole year's procedure? You start in January of one year for the estimates to be published in February of the following year?

Mr. Cross: That is correct.

Senator Grosart: Does any other ministry have this function, Mr. Minister?

Hon. Mr. Drury: You asked if any other ministry has this function?

Senator Grosart: Does Environment have environmental items broken down? Does Energy, Mines and Resources have the same?

Hon. Mr. Drury: In their respective field each department has, if you like, an overview. There has been recently established in the Department of Energy, Mines and Resources an office of energy planning which endeavours to take an overview of energy throughout all the operations of all government departments, and in consultation with these other government departments to establish the implementation of energy policies, energy projects. The same is true with the Department of the Environment, although they do not have the same access to the review procedure, by reason of their less intimate relationship with the Treasury Board Secretariat than has MOSST.

Senator Grosart: Would you say that MOSST's role in this is more or less unique in the Treasury Board operation?

Hon. Mr. Drury: Yes, I think it would be true to say it is unique.

Senator Grosart: The reason I ask is that since reading the presentation I have been disturbed by its apparent modesty, to use the nicest word. For instance, in paragraph 48, to which the chairman has directed our attention, it says:

Thus, while MOSST has not sought the central role in the development and approval of a science budget...

It seems to me from your answer and the information we have just had that it has sought, and is actively operating, a central role. How can you be more "central" than when you have this unique relationship that no other department has?

The Chairman: Senator Grosart, I think your point is well taken. I had promised that we would not come back to this.

Senator Grosart: This is what we are dealing with. You have asked us to look at these paragraphs; this paragraph makes a statement and I am questioning it in relation to the very information we have. Surely I cannot be more relevant than that? I am interested in it because I think it is important to the whole question.

Hon. Mr. Drury: Probably the difference, if any—perhaps it is a semantic difference—is that the role MOSST feels it can most usefully perform is an advisory one rather than control by fiat, or arising out of a statute. I have an implicit belief in the supremacy of reason, and that if reason is presented you do not need fiat to accompany it.

The Chairman: I hope you are not too Cartesian.

Senator Grosart: All I am saying is that it is, in effect, the enveloppe frappée, the French enveloppe frappée; you

have the envelope, you take the items out, you look at them, put them back in the envelope and the departments go ahead just as though MOSST had not intervened, but it is still a central role. That is the point I am making, because to me it is the most important matter for us to determine, whether MOSST has a central role or whether it is still an outsider. That is why I mentioned the modest, apologetic tone that I find throughout. I do not think it is substantiated by the record, and I am delighted that it is not.

Hon. Mr. Drury: Modesty is a virtue that commends itself to me.

Senator Grosart: In politics?

Hon. Mr. Drury: Even in politics.

Senator Grosart: Let me be more specific. After you have consulted with the Treasury Board analysts and discussed these matters, do you then see any revisions before Treasury Board passes them on to the departments or makes its decisions?

Mr. Cross: Yes, we are kept informed of what the Treasury Board analyst's recommendations will be to his superiors, and what the final recommendation of the Treasury Board Secretariat and Treasury Board will be.

Senator Grosart: Do you compile that? Do you make a compilation of your recommendations as against Treasury Board decisions?

Mr. Cross: Yes, we do. We keep an internal record of this.

Senator Grosart: That would be a confidential document, of course.

Mr. Cross: Yes.

Senator Grosart: Is this an overview that you make at this time, when you have all the departmental expenditure proposals? Is it an overview in the sense that you then consider "Is this adequate financing of science activities? Is it the proper breakdown of distribution of public money between the various performers; between basic, development innovation?" and so on. Do you take a look at that on an overview basis, or do you merely look at the specific proposals in A base and B base and non-budgetary?

Mr. Cross: I think what you are suggesting here is whether there is some overall framework within which individual proposals can be judged.

Senator Grosart: Not merely is there one, but do you use it? Do you actually judge it? Do you make a compilation?

Mr. Cross: At this point in time we have no overall framework within which to do this. We attempt to form a view, as the Treasury Board analysts do, of the relationship of the individual B budget proposals to government priorities, to departmental priorities and mandates. However, these judgments are made essentially within the framework of what each department is proposing, together with the input we can make on the basis of science policies, such as the make-or-buy policy.

Senator Grosart: Let me make it specific. Do you at that particular point say, "In spite of all the objectives, the funding in industry is down again this year"?

Mr. Cross: We may draw these conclusions and bring them to the attention of our management; that is so.

Senator Grosart: Of Treasury Board?

Mr. Cross: Of Treasury Board, and of our own management.

Senator Grosart: Do you at this time, for example, assess the funding, say, by universities and by disciplines?

Mr. Cross: No, we do not examine the university funding at that level. We look at the gross trends in expenditure by the three councils and try to form judgments on whether or not these represent an equitable increase for each council.

Senator Grosart: But you do indicate that you look for duplications. Would you, for example, at that stage add up the funding by universities and say, "There are 19 universities apparently ignored"? Would you make that kind of assessment at that stage?

Mr. Cross: No. Our assessment is largely at the program level itself. We do not get down to that level of disaggregation. We would examine only the proposals of each of the three councils in aggregate.

Senator Grosart: My suggestion is aggregation rather than disaggregation. Do you aggregate the figures in that sense?

Mr. Cross: I think you are suggesting that we would be examining the budgets of the councils at the level of what they are proposing to distribute to each university.

Senator Grosart: Yes.

Mr. Cross: That is not the case. We are examining the requests of councils in aggregate; that is, the total amount that each is requesting. The decisions on how these funds should be distributed is something that is left to the management of the councils themselves.

Senator Grosart: Of course, we agree the decisions may be. I am thinking of your input at that particular time.

Mr. Cross: The councils will attempt to justify the increase they are seeking. They will usually do this on the basis of whether or not they are able to cover the requests they are receiving, whether or not they feel they are covering an adequate portion of this, whether or not their costs are increasing and there are sufficient funds to enable them to meet these increased costs. However, these are fairly general presentations which do not get down to the level of coverage for individual disciplines by each council or individual university.

Senator Grosart: But you do both aggregate and disaggregate when you put out the Green Book. This is *ex post facto*.

Mr. Cross: Yes.

Senator Grosart: At what stage do you do the compilation in the Green Book? Is this after the main estimates come down?

Mr. Cross: The compilation follows the estimates. It is approximately nine months after the estimates have been presented.

Senator Grosart: Do you then decide or determine to go back next round to Treasury Board and say, "This is out of whack here"?

Mr. Cross: Perhaps I should make it clear that the detailed information presented in the Green Book is not available at the time the main estimates are presented. The level of detail which we have at estimates time and in program forecasts is a highly aggregate level by program within the departments. The detailed breakouts you see in the Green Book are achieved by further surveys carried out by Statistics Canada.

Senator Grosart: But all they are doing is adding up the figures in the main estimates.

Mr. Cross: There is additional data in the Green Book compared to what is available at main estimates time. For example, with respect to data on Manpower, the detailed distribution by region and so on is not available to us at main estimates time.

Senator Grosart: I do not understand it so I will pass, but it seems to me that the main estimates require that detail. After all, there is a program description and there is the detail in there; there is the vote, which is quite specific in many of the items. It is true that more than 50 per cent is statutory, but you still have that information in the estimates.

Mr. Cross: This information would be available at the departmental level and is subsequently collected by Statistics Canada on the basis of the final departmental estimates figures, but it is not collected by us with the call for program forecasts.

The Chairman: Yes, but you say in the brief that individual departments and agencies, while the estimates are being examined and reviewed, separate their proposed science expenditures. Surely at that time you could have an overall picture. You could add up all these figures in total.

Mr. Cross: I do not think we are disagreeing with each other. The question is at what level of detail the information is presented to us in the science addendum and at what level of detail we collect it. We collect it at the level of detail of the program itself. That is the first major breakout in a department's activities for budgetary purposes, and we do not go below that level. In the Green Book there is much information which goes below the program level and we do not have that information at the main estimates time. It would put a substantial, increased burden on departments, and for this reason at this point in time the collection of that information is done in two steps. There is the highly aggregated information with the call for program forecasts and further disaggregations of that data by requests to Statistics Canada to departments at a later point in time. They will make this request normally about March of each year.

Senator Grosart: Surely the start points for departmental estimates are under the PBB system; they require statements by objectives, by sub-objectives, by program descriptions; they require objects of expenditure and program by activities. That is required at the very start.

Mr. Cross: Yes.

Senator Grosart: If you had that, surely you would have all the detail you wanted. That is why I do not understand.

Mr. Cross: Well, for example, in the Green Book you will find a detailed breakout of expenditures by region.

Senator Grosart: Let us just take these main ones: the description of activities, the objects of expenditure and the program by activities. There may be other things added in the Green Book, but I am speaking of the main thrust of the information. That is the distribution of public moneys spent on science by activity.

Mr. Cross: By program, yes. To a certain extent by activity, but mainly by program. It is not by objects of expenditure. We do not collect that. These sums are not broken out for us for the purposes of the science addendum. They may be available within the departments, but at this point in time we do not collect them.

Senator Grosart: Would you like to have them?

Mr. Cross: I am not sure we could handle all the information at one point in time. We concentrate on the B budget items—that is, the new proposals of departments—as does the Treasury Board itself. While the detailed accounting figures may be required for estimates purposes and may be required for analyses to support requests for cost increases with respect to the A base, I do not think we ourselves would find this information terribly useful.

The Chairman: I gather that you receive many figures from departments regarding their proposals, but that there is no direct information available to you at that time on the explanation or the justification for these specific proposed expenditures. At what stage and from whom do you receive this kind of information?

Mr. Cross: We do not get that information directly, but it is available to us.

The Chairman: Where is that information?

Mr. Cross: The information is submitted to the Treasury Board by departments and during the course of review of the individual "B" Budget proposals we have access to this information from the Treasury Board Secretariat itself. But MOSST does not receive copies of this information. This is considered highly confidential and sensitive information and it is not released outside the Treasury Board.

Senator Carter: Does that mean that you form your overview simply from the aggregate figures you receive without knowing what those figures represent?

Mr. Cross: We form an overview of the trends and expenditures by departments, of the distribution of expenditures intramurally and extramurally and to industry. We have information on whether these are grants or contracts. We have information of manpower trends. But this is all at an aggregate level, at the program level. We do not have breakouts that go below that level. That information is available to departments, within departments, but it is not available to us.

Senator Carter: You do not get it on this addendum which they tear off and send to you? This is what you base your overview on, as I understood you earlier.

Mr. Cross: That is correct. This is a highly aggregated view of expenditure trends.

Senator Carter: If the Department of Energy, Mines and Resources, for example, said on their addendum, the sheet which they send back to you, that they were spending x

millions of dollars on research and new sources of energy. you would not know how much of that money was for solar energy and how much for windmill energy, or anything like that?

Mr. Cross: Not at that point in time. As the minister has already indicated, there is an interdepartmental committee which gathers complete information on actual expenditure levels in each of these fields. We would see the data and the program descriptions and the justifications for new expenditures, and specific items related thereto in the energy field and we would form some judgments on the need and value of these proposals.

The Chairman: If you get this kind of highly aggregated information, how can you make a proper assessment as to whether a department respects its own mandate? How can you detect undesirable duplications between departments and agencies?

Mr. Cross: One of the things I think MOSST adds to this system of review is the attempts we have made to form overviews of different slices of activity. We all, for example, go through all the program forecasts to look for certain new items. For example, we look for new items related to transportation, new items related to energy, new items related to the space field, new items related to the oceans, and we will find, during the course of this, that there are obviously cases where departments have not consulted with each other, where they are putting forward proposals that are quite similar. There will be more of this kind of ability to detect duplication, or lack of co-ordination, during the course of the year, as individual submissions come in requesting Treasury Board program and contract. In these circumstances we will bring the departments together, draw attention of the Treasury Board Secretariat, and try to resolve these overlaps.

Senator Grosart: You say in section 47, in speaking of the 1976-77 spending proposals, that you carry out a systematic analysis of individual departmental B budget requests, and that you make recommendations to the Treasury Board Secretariat with respect to them. You also say that in providing advice to TBS for program forecasts the ministry has been on the lookout for duplication of effort, lack of adequate interdepartmental co-ordination, research not related to departmental mandates and non-uniformities in the planning budget and management of S & T activities. Are you really saying there that you do this only on new spending proposals—that is, B budget proposals—but you do not relate them in any way to existing proposals under the A budget, the statutory one?

Mr. Cross: We give this advice with respect to B budget proposals, but each of our analysts, as well as the Treasury Board analysts, will have a good general knowledge of the department's programs, so that in forming his judgment on whether or not the additional funds for the B budget that have been requested should be approved, he is relating them to the existing program.

Senator Grosart: Who is "he"?

Mr. Cross: Our own analyst, as well as the Treasury Board analyst; but this is not done on the basis of a detailed examination of financial data. It is a kind of qualitative process.

Senator Grosart: Do you not think that it is important that somebody do this other job of relating proposals on a detailed basis to existing spending programs?

Mr. Cross: I think it is important that this be done, senator, but the difficulty we have with science proposals is the same as the Treasury Board itself faces in handling budgetary proposals as a whole. The budgetary process is designed to give attention to the new requests departments make each year, and each of our analysts, in making judgments on these proposals, has a background covering the general expenditure trends on a departmental basis as well as the trends in expenditure on a horizontal basis that we have been developing, as a kind of framework within which he can make judgments on the individual proposals.

Dealing with the A base of departments tends to be carried out both generally, by the Treasury Board, and by ourselves, outside the budgetary process, and is carried out on an aperiodic basis. For example at the moment, MOSST is conducting a review of transportation research and development in Canada, and during the course of this we are getting detailed information on all transportation research being carried out with federal government financing; but the time required to do this in-depth analysis far exceeds that which is available within the tight time constraints in the budgetary process. So there is a procedure for dealing with the question you are asking, but not in the context of the budgetary framework itself.

Senator Grosart: Would you say you were attempting to reach this goal of complete coordination by use of your task forces, and then your breakdown into your three main divisions by universities, industry and government in-house activity? Are you really going in that direction, rather than, as you say, doing it at this precise moment at which we would like to see you do it?

Mr. Cross: Yes. We are taking an approach that covers both the cyclic budgetary processes, and the non-cyclic activities of the planning of departments in the science area.

Senator Grosart: If it so happened that seven departments were funding the same discipline in the same university, at what point would you discover that, if there were some change that would bring this about? Where would you discover this?

Mr. Cross: Well, MOSST is at the present time beginning a review of departmental activities in support of universities. This is the kind of study which is carried on outside the budgetary process, and which is designed to reveal this detailed kind of information. The sort of detail you are asking for is something that can only be discovered by an in-depth analysis of a particular field. Because the resources and time required for this are very extensive, these areas have to be selected with some care, and plans made during the course of a year as to just how many of these we will carry out.

Senator Grosart: So would you say, then, that given the existing policies, and the existing resources that are available to you and to others in the way of manpower, and so on, that the case I have indicated would not be discovered until it happened?

Mr. Cross: In some circumstances that is true, yes.

Senator Grosart: Let me pass for the moment, Mr. Chairman.

The Chairman: Any other questions?

Senator Bonnell: How does the department correlate international policies with what is going on in Canada? Is

there any correlation by the Department of External Affairs of what science policy is being developed, let us say, in Germany, and what is happening in Canada?

The Chairman: I think there is a special section devoted to MOSST's role in the field of international affairs, which immediately follows the one we are discussing. So if you would like to postpone your question until we reach that stage, we can deal with it then.

I see it is 10 o'clock. The minister has to attend a much more important meeting than ours, I presume, namely a cabinet meeting, and I will certainly excuse you, sir, again. Thank you very much. Before you go, I would like to consult with my colleagues. I understand that the minister has no objection to leaving his officials available to us this morning, if we want to continue a little bit longer. I think we should profit from this opportunity.

Senator Grosart: I agree. We will not ask policy questions.

Hon. Mr. Drury: Thank you. You will have to reserve your questions for me, and my rebuttals, for later.

The Chairman: We will certainly not finish our questioning this morning on these various issues that are covered in the brief, so that we will be very pleased indeed to see you again after the Christmas recess.

Hon. Mr. Drury: Thank you. A Merry Christmas to you all.

The Chairman: Thank you, Mr. Minister, and the same to you.

Senator Carter: I would like to ask a couple of questions. In a time of cutbacks, such as we are experiencing at the present time, what procedure is adopted by MOSST? What input do you have? What is actually happening? Are you recommending selective cuts, or are you establishing priorities, or is it just an overall reduction across the board?

Dr. M. J. LeClair, Secretary, Ministry of State for Science and Technology: Mr. Chairman and honourable senators, MOSST does not have at this time a policy which necessarily says, "We will cut back on everything," or, "We will go on as usual." Every one of the items that we look at we try to judge on its own merits, and in these times of restraint, of course, our advice is not always heeded by the Treasury Board. They have targets, in terms of expenditures, as to how much it should be increased or to what extent it should be the same as last year. So in our own advice to Treasury Board, we give the best advice we can, based on the merits of the case. Whether there is funding or not is something Treasury Board takes into consideration afterwards. We do not have a fixed target in terms of decreasing the amount of money we will advise Treasury Board to spend.

The Chairman: In your review and assessment of all these proposed expenditures, I understand that you try to evaluate and assess the inputs or the amount of expenditures devoted to each program. Do you also try to measure or to evaluate the output of programs?

Mr. Cross: Not during the course of the budgetary process itself. This is something we have been attempting to do in the context of the program assessment activity during the period of the year when we have more time, outside of the budgetary process itself. We have a group of

people who have been doing some work in this field. I think it is fair to say that attempts around the world in actually evaluating output of scientific activity have been only modestly successful. We ourselves have concentrated our efforts as the development and of R & D activity. We have not attempted to try to assess the effectiveness of basic research or applied research activity.

The Chairman: I think Dr. LeClair would like to add something.

Dr. LeClair: Mr. Chairman, I think that is a very good question because I think this is the next stage in what MOSST is going to do. We have had to proceed in terms, first of all, of establishing a base and trying to find out where we can be most helpful. As Mr. Cross has said our activity for, the time being at least, in the budgetary cycle, has been mostly in B estimates, but I would not like the impression to be left that we are not interested in the so-called A base, in other words the ongoing activities. But we use a different process to get at those. Mr. Cross has mentioned, for example, the transportation study, but we are also involved more and more, at the request of some of the major departments, in some more specific studies in terms of trying to find out the details that Senator Grosart was after and finding out to what extent programs are responsive to departmental mandates.

If I may add something in connection with some of the questions that Senator Grosart was asking, for example, about the universities, we are involved in the overall funding of the three councils which fund most of the university research. We do not know before hand, nor do they, how much will be spent in each university and how much will be spent in each region. As you know, their system is curiosity-oriented, and they only know after the end of the year how much has been given to each university or to each region. But this is the kind of thing we are interested in and this is the kind of thing that MOSST is trying to develop a capability of being able to do. We are interested in finding out to what extent there are major regional imbalances in funding by the three councils. We are interested in the disciplines. At this time we are working with the Science Council and through our university branch we are looking at some disciplines. We are looking in detail at biology and are interested in finding out to what extent funding by the three councils in biology is adequate. We have done the same thing in the past for some of the veterinary schools, agriculture and forestry. It is the kind of activity we are getting involved in more and more but not necessarily through the medium of the budget cycle.

Senator Grosart: You are putting emphasis on the granting by the councils, but this points up the fact that there are other grants directed to universities under your "make or buy" policy, and it seems to me there are more grants to universities than there are to industry. I do not know how that would stand up in dollar volume but certainly in numerical volume. So where is the co-ordination here?

Dr. LeClair: First of all, the "make or buy" policy does not in itself apply to universities. The "make or buy" policy was for industry and not for universities.

Senator Grosart: In the list put out by the Department of Supply and Services there are scores of direct examples. And they call it "make or buy".

Dr. LeClair: I must repeat that the "make or buy" policy is not for universities; it is for industry. There are some

consultants in universities who get contracts from the Department of Supply and Services but that is not what we understand by "make or buy". We do not take that into account in our figures. When we talk about "make or buy" we talk about contracts to industries and new money only. Old contracts are not included in make or buy.

Senator Grosart: Unless I am very much mistaken, the departments themselves say that they are making this grant to such-and-such a university in a certain discipline and that it is "make or buy".

Dr. LeClair: No.

Senator Grosart: Well, the departments say so.

Dr. LeClair: Well, they may say so, but we do not take that into account.

Dr. Meyboom may be able to give you the figures we have. They are in the brief somewhere. Mind you the universities would like to be included in the "make or buy" and they have made representations to us. They would like to be given the same kind of preferential treatment, if I may use the word, as industry. But up to now we have considered "make or buy" strictly for industry. That is not to say, of course, that universities do not get contracts from the departments. They do.

Senator Carter: What has MOSST done to date to correct the "three solitudes" as between government, industry and universities? The committee found that each was working in its own little field with very little contact and very little knowledge of what the other was doing.

Dr. LeClair: First of all, the only thing we can say is that certainly what we have done, and this is different from what we have tried to do, but in terms of the internal organization of MOSST we have gone for a matrix organization where we hope that people in the industries branch, for example, will be working closely with people in the universities branch. Within the ministry we have set up procedures. Most of our work now is task-force oriented. Most of our work is matrix in the sense that you take people within the three branches. That is not to say that we have done very much or have been able to bridge the gaps in those "three solitudes" outside the ministry. I must say that the task is enormous but it is certainly something we are conscious of. I cannot give you specific figures as to how we have been able to bridge the gap between the three.

Senator Cameron: On the question of task forces, who is conducting the overall supervision to make sure that there is no overlapping within the ministry?

Dr. LeClair: There is a committee within the ministry which is called the Project Management Committee which meets once a week, and there is no project or task force set up without the approval of that Project Management Committee. There is a full-time person who is the secretary of this committee whose task is just this, and once a week he makes a report to this committee, to what extent there is duplication if any and to what extent these things mesh. At this time we have a study going on to tell us exactly what the trends are because we deal with these one by one. We want to make sure at the end of a week, a month or a year that they are identifiable trends which correspond to our philosophy. Our philosophy at this time—if I may open up that parenthesis, because Senator Grosart mentioned something about being too humble in our brief—is to be

low key and to be humble, in the sense that over the last year we have felt it was our mandate to gain a credibility, not only in the other departments in the federal government but also outside. To our amazement, at this time we are finding that requests coming to us, substantial requests, from other departments and from the outside are reaching the stage that it is more than we can handle, so perhaps some times humility does pay. Certainly this is what we had in mind, to be asked rather than force ourselves into their programming.

The Chairman: In the course of your review of program forecasts and other expenditure proposals, could you give us some rough idea of how many occasions you have rejected or modified proposals put forward by departments and agencies?

Dr. LeClair: Perhaps too often. I think it is hard to give you figures. We are now compiling this sort of thing. It is difficult to give you examples, which are confidential. We have on many occasions, perhaps too many, opposed what the departments are suggesting. We have also been at odds with Treasury Board. Mr. Cross has said that we give Treasury Board advice, then Treasury Board makes their own decision then let us know. We do not necessarily accept that. On some occasions we have fought; on some major occasions we have won and on others we have not won our case. However, we will go further. In other words, if the recommendation of the Treasury Board Secretariat is something we cannot agree with, we will go further and make our representations directly at the board, to the ministers themselves through our minister. On one occasion in particular we have gone in front of the ministers. There is, if you want, an appeals system, so that we can go directly at the level of ministers rather than through the Treasury Board Secretariat.

Whether we agree with departments or not, we have found that if we wait until the Treasury Board submission comes our way, or a memorandum to Cabinet, it is often too late. At that time the departments have committed themselves to a program; the minister may have signed the Cabinet memorandum, and if we wait until that late hour for our input we find that it is too late. We are now trying to work at the level of the departments before they come up with a Treasury Board submission or a Cabinet memorandum. We have found that at that level, and with that timing, we can have more influence. If we wait too long, until the thing is on paper and presented to Treasury Board, the psychology of it is that it is very difficult to get them to change their minds.

Senator Grosart: Have you considered the methodology used, for example, by the Bureau of Budget Management in the United States of attaching an officer to each department so that he would be there at that early advice level?

Dr. LeClair: We have not done this.

Senator Grosart: I am wondering if you have considered it.

Dr. LeClair: No. There are reasons for this. I think the main reason is that we do not have the staff to do it. At this time we are still looking at main departments. There are some people within the ministry, of course, who are "specialists" in terms of some departments, in the same way as some of the Treasury Board analysts have three or four major areas or major departments. However, this is not something we have seriously considered at this time.

Senator Grosart: Would you think it would be effective in getting MOSST's input at the earliest possible level, if there was agreement on it?

Dr. LeClair: Yes, I think so, although I am not so sure that I would want to see them there physically. I would rather have them under our control, because if they are sent to a department physically, they become part of the department and it is just perhaps another scientist in that department giving us advice.

The Chairman: As an alternative, have you ever considered trying to convince the government that they should apply one of the major recommendations of the Rothschild Report, to establish within each department or agency the kind of customer-contractor relationship, which apparently has been implemented in the United Kingdom and is working very well, according to some reports we have received?

Dr. LeClair: I was there two months ago and looked at this in great detail. You are right, this seems to work. However, at this time our philosophy is that we are going to wait a little while longer. They have, as you know, not yet been able to transfer any funds effectively. Some 16 per cent of all the funds of the research councils have been transferred to the departments under the aegis of the chief scientists you are talking about. Up to now the departments have given this money back to the councils; they have not yet used the Rothschild approach of customer-contractor relationship, where they are free to go anywhere. I am told that as of this year they will feel free to go everywhere whether they are councils or not. We are waiting perhaps another two years to see what happens there.

Senator Carter: I should like to come back to this overview. Is this addendum you mentioned, which was attached to the sheet which they tear off and send back, a form of headings?

Mr. Cross: Yes, it is.

Senator Carter: If so, could we have a blank copy of it?

Mr. Cross: I do not see any reason why not. It is sent to departments; it is not a confidential document until it is completed.

Senator Carter: You get this aggregate and make some sort of overview; your analysts do this, but they do not have any breakdown of the aggregate figures. Treasury Board have analysts too and they make assessments. What do they make assessments on? Is it on the same material as you have or do they have more detailed information?

The Chairman: Perhaps I could ask a supplementary question to that. Does the secretariat of the Treasury Board have science policy advisors, for instance to review their own review, or are they just program analysts looking more at the operational aspects of departments and agencies?

Mr. Cross: Their analysts are responsible for all of the activities of the particular department assigned to their portfolio. In some cases they will have scientific and technical background and will be able to make pretty good judgments themselves of the scientific merit and scientific management behind a particular proposal. However, they are not science advisors. At one time there was a science advisor in the Treasury Board. The information the analysts themselves have for science is no different from what

our own analysts have, apart from the experience they may have of the department's programs by virtue of having been assigned to a particular portfolio for some length of time.

Dr. LeClair: I think it is very important to underline that there is a great difference with the so-called B budget. We have the B budget for next year in the greatest detail. However, what we do not have in the greatest detail, and what we are getting through another mechanism, is what is already going on in the department. We make that very big distinction between what is new money and what is already there on-going.

Senator Grosart: Of course, the old money, if you want to use that phrase, is something like 56 per cent of the total budget, certainly of total budgetary expenditures, and this is one of the very sensitive areas in science policy, the decision as to what you should stop at. If you are not looking at that A budget in detail, there does not seem to be much prospect of stopping the ineffective and ineffectual programs or activities that are going on. I know you are aware of that.

Dr. LeClair: Of course, Mr. Chairman. This is what we are doing again to the limit of our resources. If we were going to do a serious study on all ongoing R & D expenditures in the federal government, we would need at least five times the resources we now have. But we are doing it piece by piece. Transportation has been mentioned. There are quite a few other important areas that we are working on at this time. It is our hope to be able to do this and to do it on an ongoing basis, and we hope to come back, say, to transportation in two or three years from now.

The Chairman: In other words, it is just the beginning of a new method and, of course, they cannot cover everything.

Senator Grosart: Except that it is all *ex post facto*, which is what bothers me. If the government said they were going to have a visible science budget published for Parliament at the time the estimates were prepared, how far would that go, given the present resources? Let me put it another way. The main estimates are available for quite a long time before they are presented to Parliament. Given your present resources, if the government said to you that you were to publish a science budget—say, a limited version of the Green Book, what would be in that science budget? What would it give us?

Mr. Cross: We would have a number of choices there, I think.

Senator Grosart: Let me just suggest some to you. Would it be able to give us expenditures by departments?

Mr. Cross: Yes, it would.

Senator Grosart: Would it be able to give us the breakdown of expenditures by performers?

Mr. Cross: Yes.

Senator Grosart: Would it be able to give us the breakdown of R & D expenditures by basic, development and innovation?

Mr. Cross: Not on the basis of the information we gather at estimates time.

Senator Grosart: Not at that time? It would not have it?

Mr. Cross: No.

Senator Grosart: What other vital information would you say could be put into a visible science budget to be presented to Parliament following up your assessment, in paragraph 38, of our recommendation, which I think is quite correct? You say:

When approved, the science estimates would be published separately, to give Parliament and the public a better idea of the size and distribution of the Government's scientific activities.

Dr. LeClair: Could I interject and ask Senator Grosart one question? You mean publishing this immediately at the time of tabling the estimates?

Senator Grosart: Yes.

Dr. LeClair: Immediately?

Senator Grosart: Yes. You say, "would be published separately to give Parliament and the public a better idea of the size and distribution of the government's scientific activities." You are referring here to a visible science budget prior to the consideration of the estimates.

The Chairman: Perhaps I could illustrate your question by referring to a document from France which was prepared by La Délégation Générale à la Recherche Scientifique et Technique, which is a document produced at the same time as the estimates are tabled in France. It is a rather elaborate document which is really capable of informing parliamentarians. I wonder if it is part of your future project to come up with some kind of publication similar to this?

Dr. LeClair: Mr. Chairman, I have to say that this is a question of policy which should be directed to the minister. In administrative terms, however, we certainly have the capability now of doing quite a bit of what you are asking for at the time of the estimates. Specifically, it would not be that kind of presentation, which in terms of production takes quite a while. But that would be a decision of the minister.

Senator Grosart: Which is why I prefaced my question with the words, "if the government said 'do it'."

Senator Cameron: Would it be a costly effort, in terms of personnel and money, to produce a program that would give everyone the information required, even it was not as detailed as might be desired?

Dr. LeClair: No, I must say that this would not necessarily be costly. We have the capability at this time and most of that information is available to us. It is a question of timing. Some of the information which you might like to have is not necessarily available to us at the time of the estimates, but quite a bit of it is available at that time.

The Chairman: In relation to your capability, I see on your diagram in the brief that under the heading, "General Director, Program Review and Evaluation Division," you have two directors: you have one director for program review, and another director for program evaluation. Working under these two directors you have four officers for program review and three officers for program evaluation.

First of all, I wonder what kind of distinction you make between the two functions, because the two services are

separate. How can you review without evaluating? How can you evaluate without reviewing?

Dr. LeClair: I will leave that question to Mr. Cross, but I did mention, Mr. Chairman, that we do now have the capability of doing it. So you are not questioning whether we have that capability.

The Chairman: No, except in the sense that you only have four officers for program review and three officers for program evaluation.

Mr. Cross: Again this is a question of semantics, Mr. Chairman. We use the term "review" to apply to the review of budgetary proposals during the budgetary process itself. The program assessment people are the people who are addressing these A base problems. We use the term "assessment" for that activity.

The Chairman: So that for this special procedure for the estimates, the study or the screening of estimates, only these four officers under the director of program review are involved at that stage.

Mr. Cross: They are most directly involved. Some of the officers on the program assessment side provide backup support of an analytic kind to the program review officers.

The Chairman: If you are satisfied that you have the capability of producing a document like this with four or five officers, you must be very efficient.

Dr. LeClair: Thank you.

Mr. Cross: We would have some help from the other parts of the ministry with work like that, Mr. Chairman.

Senator Grosart: I realize, Dr. LeClair, that this question might indicate a situation in which you would run into the kinds of headlong confrontation with departments that you are obviously trying to avoid, and I think quite properly, but have you ever recommended that any one A base science activity program be abandoned? Have you ever found one that you think should be stopped?

Dr. LeClair: No, Mr. Chairman. We have not recommended that yet. We have the feeling, however, that quite a few of them might be stopped and we are in the process of doing this through those specific studies we have mentioned before.

Senator Grosart: Yes.

Senator Cameron: On that point, Mr. Chairman, during the hearings of the Science Policy Committee across the country there were many questions about monitoring and evaluating the program. I would have hoped you had made some progress in that area before now. I gather from what you have said that not very much has been done so far.

Senator Grosart: They are getting ready.

Dr. LeClair: Mr. Chairman, I think we might mention here some of the reasons for this. One of the reasons is that we in MOSST still believe that the departmental scientists and their staff know more about science in their own fields than we do. There is always a built-in...

The Chairman: Humility.

Dr. LeClair: Realism, I should say. If you take the NRC and its labs, we feel that the scientific competence there is much greater than we could ever hope to achieve in MOSST. We could never even come close to it. Given the

austerity that we are going through now, given the major problems of funding R & D, there is a built-in mechanism for these departments themselves to weed out the non-productive, and we are finding that this is happening. Many programs are being slowed down and in some cases discontinued by the departments themselves. There is a department right now, which I cannot mention, which has scrapped quite a bit of its programs in terms of what they were doing before, because of the austerity program.

Let me take an example. Let me take the department where I was working before so that I know what I am talking about. I do not think that MOSST could tell the Department of National Health and Welfare what to do with their research money. They have a setup which is very adequate. It is based on expertise throughout the country—peer review—and MOSST would never be in a position to tell them, "This program you are doing is not as good as this other one, which you should be doing."

We can try to influence them, we can ask questions, but it would be very difficult for us to say, "Scrap this one and do this one," across the whole of the federal service.

Senator Grosart: But is one of the problems not that the scientific establishment in each department will be fighting for money without too much concern for the overall result of the battle for money of the science establishments in each of the other departments? Surely that is one of the major problems of science policy?

Dr. LeClair: I am not so sure I understand what you mean. Is this a comment or a question?

Senator Grosart: It was really a comment, but this is one of the things we came across in our study of this whole problem. You mentioned NRC, for example. I share your admiration for much of the work of this body, but not for their granting, because we found quite definitely that there was such a thing as "grantsmanship". We had distinguished scientists come before us to say that there are experts in getting grants, and that they do get them. We also found a high correlation between the membership of NRC granting committees and the beneficiaries. That is in our report. We found that to be so. That is why we say that somebody had to take an overview of the whole thing.

My earlier comment was, and it is obvious, that the science establishment in Health and Welfare, or anywhere else, is going to put up a battle for money. Surely the science policy decision has to be whether they should win it or somebody else should win it.

Dr. LeClair: Well, I agree with this, Mr. Chairman. This is what we try to do when they come up with new requests for money, through sectoral studies dealing with certain fields.

There is one thing I would like to mention. You took the example of the National Research Council, and made particular reference to the granting side of its activities. I was talking specifically about the laboratory side.

Senator Grosart: That is why I said we had some admiration for them.

Dr. LeClair: What you said about them applies to the three councils, and I think it is important to realize that these councils are Crown corporations, with full autonomy. They govern themselves, and we are in no position to start asking certain things of them, or to start telling them to do

certain things. We can only use moral suasion, if you will, and we are trying to do this through our membership in the tri-council co-ordinating committee. It has to be realized, however, that the councils are autonomous bodies who decide what their own policies are. Our only input takes place once a year when they come up for funding. Then we can exercise some influence. We could, for example theoretically, recommend to the board that this or that new program of the council be rejected, or accepted. We might then find out, at the end of the year, that the council has redistributed this money in some other way, but there is no way we can control this, because they are independent, and I do not want to leave the impression that we should control them. I think it is a positive factor in our system that there should be some autonomy in the three councils.

Senator Grosart: I agree that there has to be a degree of autonomy, but not that they should not be subject to control. I do not care what Crown corporation it may be. One of the main problems caused by Crown corporations came up in the Senate yesterday. One of them refused to give out information, and it was handed out subsequently by a non-employee.

The Chairman: You were referring to Health and Welfare a moment ago, and you were saying that you are not equipped at the moment to criticize what they are doing in terms of research and development. I remember very well when your former nextdoor neighbour, the Deputy Minister of Welfare, came before us in 1969 or 1968. The research and development program of the Welfare branch, as opposed to that of the Health branch, was very poor, I think. I would have been in a position at that time to criticize what they were doing, and I am sure that you would have been able to develop the ability to criticize what they were doing at that time in a very short while. There has probably been some improvement since, but on the whole concept of guaranteed annual incomes, for example, they were putting forward proposals to provincial governments without doing any research.

Dr. LeClair: Mr. Chairman, without commenting, of course, on the specific example you have just mentioned, this is not our role here. We have found that rather than criticizing their programs, either publicly or at the time they come up for estimates, it is much more productive to try to work with them throughout the year, and sit down with them when they consider their programs and their planning. This is what we are trying to do at this time. We consider this to be more valuable than dealing with the matter *ex post facto* in a critical way. We are trying to sit down with them and deal with them in a co-operative way. This will not get into the newspapers, it will not make headlines, but it is probably much more productive in terms of getting results.

Senator Grosart: Can you give us some information on these "displays" coming out of your computerized examination of data, which, according to paragraph 42 of the brief, does include, to use your phrase, "past expenditure trends." How does this work? Where does it fit into the expenditure approval calendar? It is *ex post facto*, is it not?

Mr. Cross: It is, but it also includes the program forecast data. When the science addendum comes in, it includes data for the program forecast period. That is, the program forecast year plus two follow-on years. Our data base also contains data on the previous years. So with each program

forecast we update the data base that we have. At the aggregate level I think you will be able to see this in some detail on the science addendum forms. This includes the information on scientific personnel, on distribution of expenditure by the natural and human sciences, intra-mural and extra-mural by region, and also breakouts on research and development and related scientific activities. This is built into our computer data base, and from it we can produce displays in various formats for aggregating the data.

Senator Grosart: Are these displays put on paper?

Mr. Cross: They are not all put on paper. We develop whatever displays we may wish to use in performing our reviews, and developing the briefs that we make to Treasury Board officials and to our own management and minister.

Senator Grosart: What is the relationship between the output of your computer activity and the green book?

Mr. Cross: At the present point in time these are two separate data bases, but we are moving in the direction of using the same data base for this purpose.

Senator Grosart: Do you find any great differences between what Statistics Canada comes up with and what your displays show?

Mr. Cross: There are some differences. We find that in some cases the personnel who are reporting data for Statistics Canada are not the personnel involved in the preparation of estimates, and because of this there are some differences in the allocation of a particular activity to science, to non-science or to research and development, as opposed to a related science activity; but we have close collaboration with Statistics Canada, and over a period of time we are narrowing these differences as both we, the departments, and Statistics Canada gain experience in this.

Senator Grosart: I am sure you recall that Statistics Canada, in their evidence before us, said that there were "significant" differences—that was the adjective they used—between the information the departments gave them and the information they gave the committee. Is that particular gap narrowing?

Mr. Cross: I cannot comment on what they have given the committee, but I think certainly we are working towards narrowing these differences. There is an inter-departmental committee on scientific expenditures which addresses itself to these issues, and we think we are improving the data all the time.

Senator Grosart: Is there fairly good agreement on terminology and definitions?

Mr. Cross: Yes. This is standard. We, for our part, use the Statistics Canada definitions. We have not attempted to develop our own.

The Chairman: But in those times I do not want to appear to be too critical.

Senator Grosart: You are leaving that to me.

The Chairman: That is your role. It seems to me, looking at what Statistics Canada is producing and at your Green Book, that I get more information, and more advanced information, from Statistics Canada than I get from the Green Book. For instance, this publication here

entitled "Federal Government Activities in the Natural Sciences 1973-1975," we get all kinds of explanations of programs. I agree they are sketchy, but at least we have some idea of what is going on in terms of programs, instead of having just a mere collection of figures and data, as shown in your Green Book. Then I have this other publication, "Federal Government Activities in the Natural Sciences," and I presume it has not yet been published but it is available. We have all the figures already given by Statistics Canada for 1975-76, which we do not have in your Green Book. So it seems to me you could leave that function quite easily to Statistics Canada and then try, if the minister allows, to work on a document, like the French document, which is produced every year and which would be much more helpful for parliamentarians. There would not then be any more duplication and perhaps Statistics Canada should get out of estimates and concentrate on expenditures. I do not think it is part of their role to deal with estimates, but it is part of your role to deal with estimates and to comment on estimates.

Dr. LeClair: Mr. Chairman, that is a point well taken. We have been looking at this carefully and we have been somewhat troubled by the two publications. The reason we do not see as much commentary there as here is because it is already there and we do not want to reproduce it. We have been very concerned in discussing this as to whether there should not be just the one publication rather than two. But again the timing is difficult, and there is the question of bringing them closer together and deciding to what extent the information is needed and in what form.

The Chairman: It seems to me that the timing is different, and Statistics Canada is producing figures before you do.

Dr. LeClair: We get these figures from them.

The Chairman: In any case, I think that as far as I am concerned I am quite prepared to leave it at that. Perhaps at some stage our director of research, Mr. Pocock, might get in touch with your people to discuss this whole problem of data and statistics. When we made our first inquiry, back in 1968, there was a great scarcity of data, and it seems to me that now we have too much data and not in the form that would be as useful as it could be to parliamentarians. I think that now some kind of division of labour has to be organized so that it may be done more efficiently than it appears to be done at the moment. I think that as a result of these discussions you might report back on this.

Dr. LeClair: Mr. Pocock is welcome to any data we have and it can be made available to him at anytime. There is, however, I must say, still the question of policy as to whether we will do it in estimates or continue to do it as at present. The only input I want to make here is that we are able to do it whichever way we are asked.

Senator Grosart: I think, Mr. Chairman, you meant to say too many data, rather than too much data.

The Chairman: You are not the first to correct my English.

Senator Grosart: I was not correcting your English at all.

The Chairman: I remember Dr. McTaggart-Cowan was complaining about my English. If you continue to criticize my English, then I might start to speak French.

Senator Lang: Dr. LeClair, in connection with your analysis of budgets, what trends have you noticed in R&D expenditures?

Dr. LeClair: We have tabled some data. There are quite a few trends. As the minister mentioned overall there is not as much of an increase in expenditures as we would like to see in terms of R & D. As you know the intramural momentum is still going on. That is a very, very difficult locomotive to stop despite all our efforts. There has not been as much progress as we would have liked in terms of contracting out to industry. If you look at the figures we tabled this morning the "make or buy" is one little aspect that is very encouraging. The figures are changing very dramatically even though the overall R&D in itself in terms of percentages is not changing. We are looking at the trends in terms of the social sciences, and that is not moving as quickly as we would like to see it move. There are some movements in that field, but not necessarily very rapid. In terms of other trends, there is an indication I think, that universities are getting more interested now in applied research. They are more conscious of the fact that the country does need their services. We find that three or four years ago to do applied research in a university was considered second class, but that is not the case any more. If I may use the modern term it is considered to be "in" to be doing applied research in universities now. We find in a field which I know very well, for example, health care delivery research, which four or five years ago was not considered to be important and was not considered to be academic, that now everybody wants to do health care delivery research in most schools of medicine. There are quite a few others which do not come to mind right away but which I hope are more explicitly dealt with in the green paper we tabled this morning.

Senator Lang: In terms of an atmosphere of financial stringency, do you find that that bears more heavily on the "buy" end of the "make or buy" program than it does on the "make"?

Dr. LeClair: Of course it does. The problem is that the "make or buy" policy applies so far strictly to new money. It is only with B budgets and new money that the "make or buy" can be dealt with. Now, if you do not have any new money, then you do not have any money to buy rather than make, and given the escalation of salaries in the public service to scientists and others in the labs and the inflation in terms of equipment and material, we find that most of the new money goes into doing the same volume of work as they were doing before, so that there is very little new money left for the "buy" part of "make or buy". I think it is fair to say at this time that for every new program that comes up, the onus of proof is on the department and if the department cannot prove that this has to be done in-house, then the recommendation is that this has to be contracted out, and the onus of proof is on the department.

Senator Grosart: They have done very well.

The Chairman: Well, I think this is a good time to come to a conclusion for this morning.

Senator Grosart: Could I ask another question?

The Chairman: Yes.

Senator Grosart: You break down the total expenditures on science activity into two major categories—non-R&D and R&D. How significant is the balance between the two?

Have you done any work on this? Should there be a relationship?

Dr. LeClair: Yes. Between R&D and RSA—that is, related scientific activity—should there be a relationship between the two?

Senator Grosart: Yes, an overall relationship.

Dr. LeClair: I do not know. To the best of my knowledge this is a problem we have not looked into. Perhaps I might ask some of my colleagues whether they have any views on this. I must say, this is not something we have looked at. Have you, Mr. Cross?

Mr. Cross: We have not examined this. There are different kinds of related scientific activities. Many of the related scientific activities are directly in support of the regulatory or control functions the department performs, so I think one has to make a judgment about the relative levels.

Senator Grosart: That is what I was asking, if an overall judgment has been made.

The Chairman: In theory there should not be any very significant relationship, because in related science activities you refer to technical services and information services, which are not necessarily related to R&D.

Senator Grosart: The reason I ask the question is that it is because it is one of the questions you ask in comparative international operations, what percentage of the total is going into R&D, and then you go on to what the R&D is.

Dr. LeClair: It might be an interesting thing to do. I think it would be fairly easy. We might find out, for example, that most countries have a relativity which is very close to one another. We might find it varies, that it goes up and down. It is something we should perhaps look at.

Senator Grosart: It will relate also to the breakdown between capital and operating expenditures, because you would have a different balance; probably in related activities there is a higher percentage of capital expenditure. That would be just a guess.

Senator Lang: I have one final question, which is not entirely relevant. I would like your comments on the report in the papers this morning of the remarks of the ex-United States ambassador in Ottawa deploring the decline in co-operation between Canada and the United States in scientific and technological matters. Do you think that is a fact? I do not mean the comment, but the decline?

Dr. LeClair: It has been mentioned to us recently. We have had no indication of this in the ministry. We have a document which gives us in great detail, for almost every single program, the amount of co-operation that goes on between the two countries. It is a few hundred pages long, which gives an idea of how much co-operation there is. It has never been quantified. There is a lot of co-operation in the scientific field that is not necessarily official.

Most of our scientists are on a first name basis with many of their counterparts in the United States; they belong to the same societies; they travel there extensively. These things are very difficult to quantify. Everybody says there has been some kind of deterioration but I have not seen any figures for it. Certainly I have not heard of any hard data that might prove this.

There is one thing I might mention here. Those countries with which we have most scientific exchange are the countries with which we have no official bilateral accord. Perhaps this indicates that when you have an accord it is because you need it. That there is not enough going on. Certainly, with for example, the United Kingdom and the United States, where most of our exchanges in the scientific field occur, there has never been any protocol or official accord, so it is very difficult to quantify how much is going on.

The Chairman: I have some questions about that section of the brief, but I think we should adjourn now. I assume we have finished our questioning up to subsection (2) of section C of the brief, with one exception. When the minister comes back before us, I think we should ask him about the question of having a more extensive document made public, giving us the proposed science expenditures more

or less along the lines of the document to which I referred, which is being produced in France, at the same time as the main estimates are published. This will be the only question that will be covered in respect of these subsections at our next meeting.

I would propose that at the next meeting we spend most of our time on the responsibilities of MOSST in relation to industrial strategy, international affairs, scientific manpower, and the role of MOSST in technology assessment. I am sure that if we cover that ground we will have enough material at the next meeting. I am afraid we will need two other meetings with you, gentlemen, in order to cover the rest of the brief at the final meeting. Is this satisfactory?

Hon. Senators: Agreed.

The Chairman: Thank you very much indeed, Dr. LeClair and Mr. Cross.

The committee adjourned.

APPENDIX "9"

THE GRANTING RESEARCH COUNCILS

Goal, Objectives, Functions

After considering several studies of the federal structure for supporting research, such as those of the Science Council, the Organization for Economic Cooperation and Development, and the Senate Special Committee on Science Policy, the Federal Government has decided to reorganize its granting institutions in order to ensure that each group of disciplines and activities receives appropriate recognition.

The proposed reorganization will affect the National Research Council and the Canada Council while the Medical Research Council will remain basically unchanged.

The Government proposes to transfer the granting function of the NRC to a new body, to be called the Natural Sciences and Engineering Research Council, leaving the NRC free to concentrate on the operation of its laboratories which will continue to be oriented toward furthering scientific and technological development in Canada. (The Canadian Institute for Scientific and Technical Information, formerly called the National Science Library, will continue to be associated with the NRC.) In a similar way, the Government proposes to transfer the granting function of the Canada

Council in support of the social sciences and humanities to a new body, to be called the Social Sciences and Humanities Research Council, leaving the Canada Council responsible for supporting the arts. The Medical Research Council will continue to support research in the health sciences. Thus, five councils will replace the present three institutions. Three of them will be granting research councils.

Each granting Research Council will report to Parliament through a Minister designated by the Governor-in-Council. The members of each will be appointed by the Governor-in-Council. Each Council will develop the philosophy which will underlie its programs integrating into it the goal and the objectives which have been outlined by the Government while maintaining autonomy in regards to its procedures and to the distribution of its funds.

In the Speech from the Throne of February 1974, the Government recommended that the support of a balanced development of knowledge and research capabilities be the goal of the granting Councils. The announcements accompanying the Speech from the Throne specified the following objectives:

- to encourage curiosity-oriented research,
- to maintain a basic capacity for research training,
- to provide a base of advanced knowledge,
- to assist in the selective concentration of
research activities,
- to seek a regional balance of scientific capability,
- to encourage research with a potential for contri-
buting to national objectives,
- to encourage excellence in research.

In order to attain these objectives the Councils will address themselves to research, basic as well as applied, which serves the twofold purpose of training scientists and scholars and advancing knowledge.

The Councils will have to take into account the need for a reasonable regional balance of scientific capabilities. Using accurate information about promising researchers and applying appropriate safeguards for excellence, the Councils will contribute to developing the capacity for high quality research in all parts of the country.

The Councils will pay due attention to the development

of research capabilities and the advancement of knowledge in areas of national concern.

In supporting research, the Councils' main responsibility will be to stimulate and preserve standards of excellence. The Councils are the trustees of quality.

The granting Councils while supporting research, will not carry out particular research activities themselves. They will examine and encourage the initiatives of researchers and they will communicate regularly with the research community and its host institutions in order to ensure a continuously updated awareness of potential needs and opportunities.

Part of the support provided by the existing Councils has been in response to proposals submitted by individual researchers. A number of projects were judged worthy of support on the basis of the originality of the project, the reliability of its methodology and the actual or potential excellence of the researcher. This important way of supporting research will be retained.

Another way which has been developed is that of concentrating support in agreed-upon areas. For example,

Councils have initiated development grants, programme grants, major editorial grants etc. The experience gained in this regard will be carried into the new Councils. It is in this context that interdisciplinarity should be envisaged. It has already been recognized that the complexity of many of the problems confronting our society at present requires interdisciplinary research to understand these problems as well as to devise solutions. The Councils should further encourage such projects.

A proper balance will have to be achieved among all ways of supporting research; peer assessment will continue to be integral to the evaluation of all projects.

While serving the advancement of knowledge, research supported by the Councils contributes to the training of students. Therefore, the level of support provided in any particular discipline, including support of graduate students, should be responsive to foreseeable demands for research trained graduates.

In support of this philosophy, the Councils will need to gain an insight into the training and deployment patterns of university educated persons generally and of

research trained persons in particular. Accurate information on this subject is not readily available for all disciplines. The post-censal Highly Qualified Manpower survey jointly sponsored by the Ministry of State for Science and Technology and Statistics Canada and the analyses which will subsequently have to be carried out, represent an attempt to improve the information on the subject and should assist the Councils in their decision-making.

In the announcements accompanying the Speech from the Throne, the Government also declared its intention to establish an Inter-Council Coordinating Committee. It will be composed of the Presidents on the three granting research Councils and the Secretary of the Ministry of State for Science and Technology who will be its Chairman. Other Senior Officials may be asked to participate in the deliberations on occasion, depending on the subject matter under discussion. It will report to the Minister of State for Science and Technology.

The Inter-Council Coordinating Committee will help the Councils to meet their objectives. It will not have any executive authority. It will be given the following general

terms of reference: to ensure coverage of all recognized disciplines; to ensure that the needs of interdisciplinary research are met; to harmonize granting practices; to provide a forum for the discussion of questions on matters of interest to all three Councils.

In order to fulfil its functions, the Inter-Council Coordinating Committee will need to consider information from multiple sources: First, there are the Presidents of the Councils, each of whom will have expert advice from his own Council and advisory and assessment committees, and who, of course, can solicit or receive any such advice as he wishes or as is forthcoming. Then there is the Secretary of the Ministry of State for Science and Technology who will provide information and advice collected or received by the Ministry.

All other necessary information may be gathered by the Inter-Council Coordinating Committee through consultations by briefs, hearings or discussions with individuals, organizations or institutions.

APPENDIX "10"

NRC 1974 —

A Redefined Role

(Extract from the Report of the President 1974-1975).

The role of NRC within the overall Canadian research and development effort has been unique, and throughout the Council's long history this role has evolved continuously in response to new needs or opportunities. As an independent research agency with its own governing council, NRC was encouraged to develop a strong Canadian R & D capability and high quality scientific expertise available to governments; to the private sector and to Canadian citizens.

By the mid-sixties NRC had developed a highly competent group of laboratories and a multi-disciplinary research capability dedicated to national development. Through NRC leadership and support, university laboratories had developed strength in most scientific disciplines to the point where it was no longer necessary for Canadian students to seek high quality scientific training outside Canada. NRC had made substantial progress in promoting and assisting research in industry, although the development of high technology industry in Canada has been generally retarded for reasons that are well known and largely unrelated to science and technology.

Compared to its near-colonial status of the forties, Canadian science and technology had reached a degree of maturity and of R & D capability where they could henceforth contribute more effectively to our national development. During the past decade NRC policies have been directed toward greater and more effective utilization of this national research potential in support of Canadian needs and opportunities. Additionally, in order to adapt to static or declining budgets and to improve the effectiveness of Canadian research endeavors, continuing efforts were made to consolidate research programs and to promote closer research collaboration between industry, university and government sectors. However, further and more fundamental changes are now required.

In recent years it has been national policy to restrict growth of R & D activity in the government and university sectors and to accord higher priority to industrial R & D. The announced "contracting-out" (make or buy) principle is a specific action in line with this policy. It is probable that these general policy directions will be continued for some time into the future. Additionally, a number of long-term problem areas are now of growing national concern and will clearly require expanded R & D effort.

Early in 1974 the federal government announced its decision to separate the University Grants and Scholarships Program from NRC and to set up a new granting Council to take over this function. In the past, NRC has from time to time "spun off" major activities it had developed, e.g. Atomic Energy of Canada Limited (AECL), Defence Research Board (DRB), Medical Research Council (MRC). However, the separation of the university grants function, which has been one of the cornerstones of NRC's broader science role in Canada, represents a more fundamental change. The present situation demands less emphasis on the general development of science and more emphasis on effective ways of using the demonstrated capability of NRC for our national development. In the future, NRC activities will be largely centered around its laboratory programs and such extramural research programs as may be undertaken will be closely coupled so as to support or extend laboratory programs.

The Redefined Role and Policies of NRC

Although NRC's principal function is research in

science and engineering, its specific research activities must nevertheless be well focussed and its overall role must be clearly defined within the total Canadian scientific research and development effort. As a guiding principle, NRC must build on its existing strengths and capabilities; it should concentrate on those things it can do best and on those things which are deemed highly important from a national standpoint but which, for various reasons, cannot be done by other agencies.

The following activities will form the basis of NRC's future research program:

- i) basic and exploratory research;
- ii) long-term research, including selected areas of advanced technology and research directed toward problems of ongoing national concern;
- iii) industrially-oriented research and research services to industry;
- iv) research to provide technological support of social objectives;
- v) specialized major research facilities developed and operated as national facilities;
- vi) physical measurements and standards.

The following specific policies relate to the above activities:

- In order to maintain its scientific and engineering competence and close contact with the advancing scientific frontier, NRC will continue to perform basic and exploratory research for the creation and application of new knowledge. The level of this effort will constitute from one-quarter to one-third of NRC operations.

- NRC will place emphasis on research in selected areas of advanced technology of high promise and on research related to long-term problems of national concern, such as energy, food, building and construction, and transportation.

- NRC's industrial research and development role will continue to complement and reinforce R & D in Canadian industry by the development and transfer of technology and by direct assistance to R & D projects in industry.

- Within its competence, NRC will continue to provide research support toward social objectives such as public safety and security, protection of property, health, and environmental quality.

- NRC will continue to establish and manage major scientific and technical facilities that serve a variety of users.

- NRC will provide a national reference center for standards of measurement and performance standards.

Because of NRC's non-regulatory nature and independence as a research agency with broad scientific expertise, it is frequently called upon for consultation or to undertake investigations on specific matters. In some cases this amounts to a kind of "scientific ombudsman" task. Accordingly:

- NRC recognizes an obligation to provide, within its competence, independent investigation of scientific and technical issues that are in the national interest.

In addition to the primary role of NRC set out above, its research activities will necessarily interface with, and complement, those of other government laboratories, industries and universities. The following policies define these interrelations more explicitly:

a) Relations with Federal Government Departments and Agencies

Federal government departments with no laboratories of their own, or other departments with R & D programs specialized to a particular mission, frequently require assistance in areas in which NRC has expertise or facilities. In addition to continuing to supply such assistance, NRC also has a continuing responsibility to do work of importance to Canada which does not fall within existing departmental missions or which broadly encompasses a number of missions. The following specific policy statements have been adopted:

- In selected *program* areas, either through the NRC mandate or by specific agreement with government departments and agencies, R & D activities undertaken by NRC may be directly related with the programs of federal departments and generally will constitute a specified or complementary research component of an integrated federal program.

- NRC will continue to engage in cooperative research and development at the *project* level with researchers in individual government departments and agencies.

- Within its capabilities, NRC will continue to respond positively to requests from federal departments and agencies for service from its unique facilities.

- NRC provides scientific and engineering advice, as appropriate, in support of other federal departmental programs when the required expert knowledge resides within NRC. As an independent agency, NRC will not accept responsibility for regulatory activities of government departments and agencies.

b) Relations with Industry

Within its capabilities NRC meets the research needs of industry in Canada through the research of its laboratories, staff consultations, information services, project grants or contracts, and other forms of assistance. NRC will complement and assist research in industry and will encourage and assist, where feasible, R & D projects to be carried out in industry.

New emphasis will be given to a closer coupling of NRC laboratory research and industrial R & D in selected projects. This will involve increased NRC initiatives in developing collaborative research projects with industry. Project proposals developed by NRC laboratories for collaborative work to be carried out in industry will be eligible for assistance through grants or contracts.

These and other approaches are directed toward a more effective transfer of technology from NRC laboratories to industry. Specifically:

- NRC will develop from existing and future resources (including the Industrial Research Assistance Program (IRAP) and NRC laboratories) a program specifically directed to enhancing applied research and technological development and its transfer into industry. This involves the formation of joint NRC/industry teams to work on selected projects which may be initiated by either industry or NRC. In either case the responsible involvement of NRC must be established and funding will be subject to negotiated agreement.

- NRC work on a proposed industrial technology, if it continued to be promising, would be pursued to a point where a competent company or group of companies could see its value and would be prepared to take over final development and application. Bringing a company or companies to this point will usually require that they participate in the research at an early stage. Assignment to a company

will depend upon the company's overall capability and on its plans regarding exploitation.

- NRC continues, although in future on a more selective basis and in cooperation with Canadian universities, to encourage and assist in the creation and strengthening of R & D teams in industry, through the introduction of new staff and exchanges between industry, the universities and the NRC laboratories.

- NRC will provide scientific and engineering advice and assistance in solving technological problems, as appropriate, in support of Canadian industry when the required expert knowledge resides within NRC.

c) Relations with Universities

To maximize the utilization of scientific and engineering research capability in Canadian universities which NRC has fostered over the years, it is desirable that strong interactions continue between NRC, industry and the universities. Therefore, NRC will need to maintain strong cooperative interfaces with the new university granting council.

- In fields of research where NRC has identified the possibility of significant advances in fundamental techniques, maximum collaboration will be sought from university researchers.

- NRC will continue to participate in cooperative and collaborative research programs with Canadian universities (through agreements or contracts) when the results of such research are considered to be a contribution to national research and development programs in which NRC has an identified responsibility.

- NRC will continue to encourage the interchange of scientific and engineering personnel between NRC and university laboratories.

d) Relations with Provincial Research Institutions

Since a number of provincial research councils and foundations have objectives somewhat similar to NRC's national role, NRC's activities should, where possible, be related to those of provincial institutions in a series mode rather than in parallel.

- It is considered desirable to have engineering and scientific R & D resources locally or regionally accessible to the need for such resources. It is therefore NRC policy to regard provincial institutions as having prior responsibility for the satisfaction of provincial needs within their capability. NRC will respond to requests that cannot be thus satisfied.

- NRC will be prepared to engage more actively in cooperative R & D with provincial agencies when the unique capabilities of both should be jointly employed to further a national R & D purpose.

Objectives and Program Activities

Following on the redefinition of NRC's role and policies, program objectives have been reformulated and necessary modifications to program activities are being implemented. Three separate programs have been defined, and each will be financially supported by a separate Parliamentary Vote.

PROGRAM A: Natural Sciences and Engineering Research

Objective

To provide a national foundation upon which to build for the creation, application and use of knowledge derived from the natural sciences and engineering.

Sub-Objectives

- To promote, assist and perform research for the creation of new knowledge derived from the natural sciences and engineering.
- To apply knowledge derived from the natural sciences and engineering to the solution of problems of national concern.
- To apply and use engineering and the natural sciences to assist industry in Canada with the development of new and improved processes, methods, products, systems, techniques and services.
- To develop and maintain national standards and criteria based on the natural sciences and engineering.

Program Description

Basic and Exploratory Research in the Natural Sciences and Engineering — Development of engineering fundamentals; acquisition of new engineering technologies; discovery of new applications for engineering technologies; development of scientific competence; acquisition of new scientific knowledge; discovery of new applications of science.

Research on Long-Term Problems of National Concern — Application of engineering and scientific expertise to the solution of long-term problems of national concern such as transportation, energy, food, building and construction.

Research in Direct Support of Industrial Innovation and Development — Performance and promotion of exploratory and applied research in selected areas for the advancement of technology required for Canadian industrial development; through effective methods of technology transfer, financial assistance and selected cooperative projects on processes, systems, materials and products, to strengthen the research, development and innovative capacity of industry in Canada.

Research to Provide Technological Support of Social Objectives — Application of scientific and engineering expertise in support of national objectives such as health, law, safety, environmental quality and quality of Canadian life.

National Facilities — Provision and management of common purpose national research and development facilities as a service to industry, governments and universities.

Research and Services Related to Standards — Research in the field of primary physical standards and provision of services in support of national and international standards activities.

Administration — Administrative support including financial and personnel services for this and other programs of the Council.

PROGRAM B: Scholarships and Grants in Aid of Research

This program will continue to be administered by NRC until the proposed Natural Sciences Research Council is established, at which point it will be transferred to the new Council.

Objective

To promote and support the development and maintenance of research and the provision of highly qualified manpower in the natural sciences and engineering.

Sub-Objectives

- To support excellence in research for the creation of new knowledge in the natural sciences and engineering.
- To promote and support the development of research in selected fields of regional and national importance.
- To assist in the provision and development of highly qualified manpower.

Program Description

Peer-Adjudicated Grants — Grants for research expenses and equipment costs awarded to selected individuals and groups on the basis of peer adjudication.

Developmental Grants — Grants negotiated with individuals, groups (including multidisciplinary groups) and institutions for major research installations, research programs, special research projects and regional development of research capability, to meet needs or opportunities to contribute to the resolution of problems related to scientific, economic and resource development.

Highly Qualified Manpower Training and Development — Scholarships and fellowships awarded in national competitions to graduate students, postdoctorate fellows and senior scientists and engineers in universities and Canadian industry for advanced study or research and professional development, tenable in universities, industrial firms and other institutions in Canada or abroad.

National and International Activities — Grants to support national and international scientific and engineering conferences and studies, the exchange of scientists and engineers, and selected activities of scientific and learned institutions.

Administration — Administrative support services.

PROGRAM C: Scientific and Technical Information*Objective*

To facilitate the use of scientific and technical information by the government and people of Canada.

Sub-Objectives

- To provide and maintain services associated with scientific and technical information to meet the needs of the government and people of Canada.
- To conduct research into the need for and methods of accomplishing the transfer of scientific and technical information in response to user needs.
- To participate in the overall provision of library and information services for the government and people of Canada.

Program Description

Information Services — Operation and support of services to provide for the collection, storage, retrieval, analysis and transfer of scientific and technical information; support for the publication of journals of research in engineering and science.

Network Implementation — Implementation and maintenance of a Canadian network of scientific and technical information services and a referral service network including the establishment of links with other national and international networks and services.

Research and Development — Research into the requirements for collection, storage, retrieval, analysis and transfer of scientific and technical information; improve-

ment of these and other related processes and development of new processes to meet the demonstrable needs of the users; development of standards, procedures and processes for intersystem exchanges of scientific and technical information through participation and agreement with other national and international organizations.

Organization and Program Implementation

In order to carry out NRC's redefined role, as well as to improve upon existing arrangements, a new management and organizational structure has been adopted.

The rationale for these changes was based on the following considerations:

- i) the need to achieve a better two-way communication between the laboratories and the governing Council;
- ii) the desire to reduce the number of standing committees of Council, including Divisional Advisory Boards;
- iii) the necessity to provide for greater participation and input by laboratory directors and laboratory research personnel in management decisions and planning of NRC activities;
- iv) the increasing need to undertake major research projects requiring interdisciplinary or interdivisional cooperation and research collaboration with external laboratories.

The form of organization adopted, which is shown schematically in the figure at the end of this section, is based in part on a "matrix" type of management. It involves the mutual interaction of two components: a hierarchical or vertical structure as displayed in the organization chart, coupled with horizontal cooperative projects involving joint participation by a number of laboratories. The focus and coordinating center for these two structures is the Management Committee composed of the President, Vice-Presidents, and Group Directors (Laboratories).

The role of Group Directors is to represent the laboratories on the Management Committee to which they are appointed by Council for a specified term. Each Group Director will be chosen from a related group of laboratories, namely: Engineering Laboratories, Physical / Chemical Science Laboratories, and Biological Science Laboratories. In discharging his responsibilities on the Management Committee, each Group Director will work in close consultation with Directors in the same group.

The Management Committee will function as a bridge between the research staff and the governing Council. It will assist Council in formulating policies and be responsible for implementing agreed policies and program activities. It will give consideration to research proposals

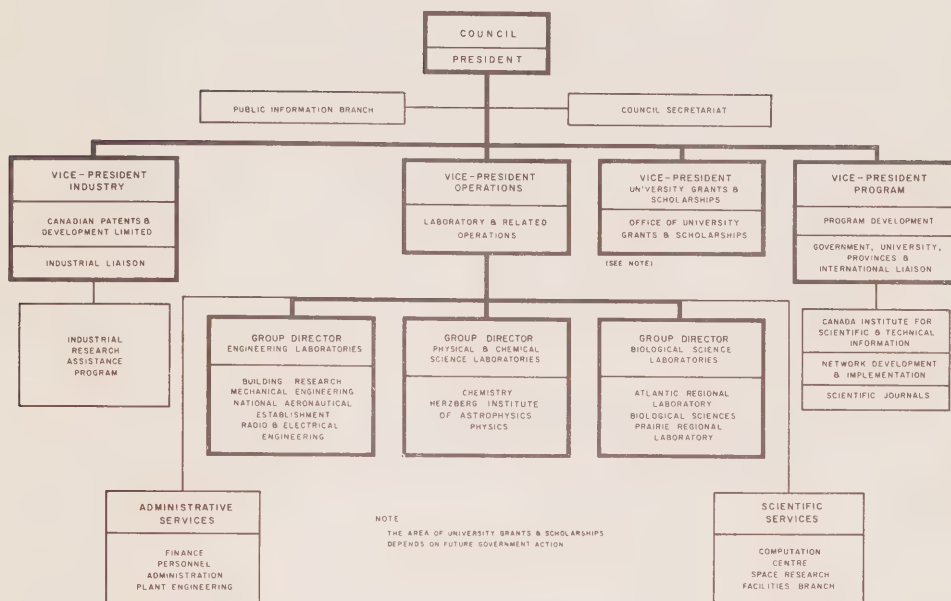
originating either from the laboratories or externally and arrange for their evaluation or further development. Additional resources will be made available, if necessary, for feasibility studies and consulting services to assist the development of promising ideas and concepts.

This also touches on the question of planning and priority setting — matters which now assume much greater importance with near-static budgets. In the past, planning and analysis studies were carried out (on a trial basis) separate from or loosely related to research operations. These have been only partially successful and this experience clearly demonstrated that such studies must become an integral part of research operations themselves. In other words, those who will be responsible for implementing research programs must also be involved in the planning process from the outset. Policy planning (or strategic planning) is the responsibility of the executive of NRC and the Council, who can call upon whatever assistance they require from NRC staff. On the other hand, program planning (or tactical planning) must be a collective responsibility of NRC staff and in this respect, laboratory directors and the Management Committee serve as main focal points for this process. The basic aim is to involve the vast amount of talent within NRC in the shaping of future research to a greater extent than has been the case up to now.

While the new organizational structure will preserve vertical authority and responsibility, it will also increase our ability to manage interdisciplinary and interdivisional projects. Selected major research thrusts of this kind will be complementary to ongoing divisional programs. In adopting the modified program activities, policies and management system, the proven advantages of laboratory units, functional structures and individual initiative will be retained. A further overriding aim must be to maintain at NRC the stimulating atmosphere conducive to research which has been fostered over the years and which is so highly valued. This depends, however, far more on highly competent researchers with strong motivations and the opportunity to develop their special talents than on particular organizational structures.

There are, however, very positive advantages in some instances in regrouping particular research activities. One such change (which was announced previously) involves the bringing together of a number of related research activities in astrophysics to form the new Herzberg Institute of Astrophysics. Also, the Canada Institute for Scientific and Technical Information which was recently officially inaugurated incorporates all of the Council's activities in scientific and technical information. Other regroupings or organizational changes may be desirable as ongoing programs develop or change and new programs are initiated.

National Research Council of Canada



APPENDIX "11"

TRENDS IN SCIENCE EXPENDITURES

PROGRAM REVIEW & ASSESSMENT BRANCH

JULY 16, 1975

SUMMARY

An examination of historical trends in science* spending leads to the following conclusions:

1) Although science expenditures have declined as a proportion of federal spending since 1968-69 (see Table 1), this decline is not unique. A similar decline can also be seen for all federal operating and capital expenditures (Table 1) and is due to an approximately \$7B increase in transfer payments since 1971-72.

2) Examination of the real (deflated) value of intramural science expenditures shows that although they grew strongly up to 1972-73, they have since been declining slightly in real value. While they still show an advance in real growth over the total federal operating costs, this advantage is rapidly diminishing, apparently because a lower priority has recently been given to intramural scientific research than to other operating expenditures.

3) Comparison of total and scientific capital expenditures demonstrates that growth in this science sector has also recently lagged behind the total.

4) Finally, we find that extramural science expenditures, after a rapid real growth during the 1960's (up to 302% of the 1963-64 level by 1971-72) have declined slightly (to 298% of the 1963-64 level) by 1975-76. That this decline is not quite as large as that of the intramural science expenditures may be due, in part, to the initiation of the Make or Buy Policy.

Table 1

Fiscal Year	<u>Science</u>	Expenditure Type	
		<u>Total Operating</u>	<u>Total Capital</u>
		(Percent of total budget)	
1963-64	4.37	52.45	7.43
1964-65	5.06	51.30	7.32
1965-66	5.65	51.51	7.49
1966-67	5.64	50.28	7.38
1967-68	5.86	48.60	7.53
1968-69	6.21	50.59	6.68
1969-70	5.87	51.88	5.33
1970-71	5.90	49.42	4.67
1971-72	5.64	48.69	4.77
1972-73	5.71	49.54	4.48
1973-74	4.76	45.42	4.74
1974-75	4.17	42.66	4.47
1975-76	4.16	44.16	5.32

* Only natural science data (about 75% of the total) are available for a long enough period to permit analysis.

TRENDS IN SCIENCE EXPENDITURES

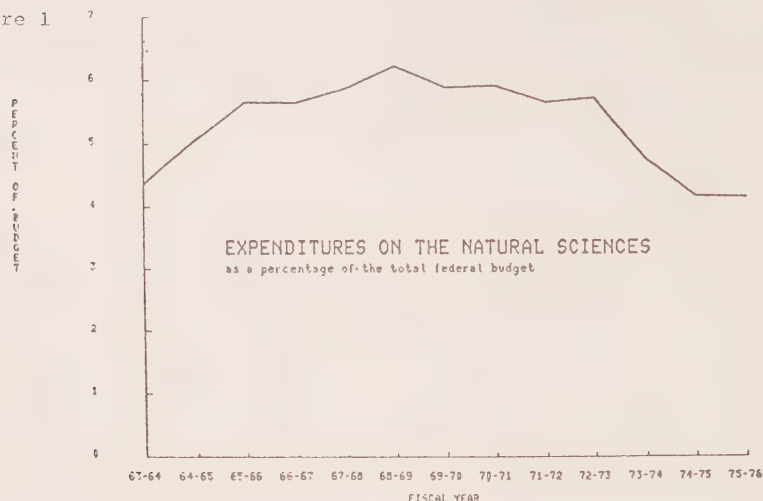
The following report presents an analysis of historical trends in Canadian science expenditures and is primarily intended to answer the question "Why are science expenditures declining as a proportion of the federal budget?".

Only expenditures in the natural sciences have been recorded long enough (as a consistent series since 1963-64) for analysis of trends in spending to be considered. Human science figures (only collected since 1970-71) are presently being readjusted by Statistics Canada in order to establish a consistent historical series but are, at present, unusable. While the following analysis is therefore restricted to natural science expenditures, it should still reflect trends in overall science spending since they do represent approximately 75% of all scientific expenditures.

The Decline

Figure 1 (below) shows that expenditures on the natural sciences, having reached a maximum of 6.21% of the 1968-69 budget, experienced a gradual decline to 5.71% in 1972-73 and a much sharper drop in 1973-74 (to 4.76%) and 1974-75 (to 4.17%)*.

Figure 1



Although Figure 1 clearly illustrates a decline in science expenditures, it raises two immediate questions:

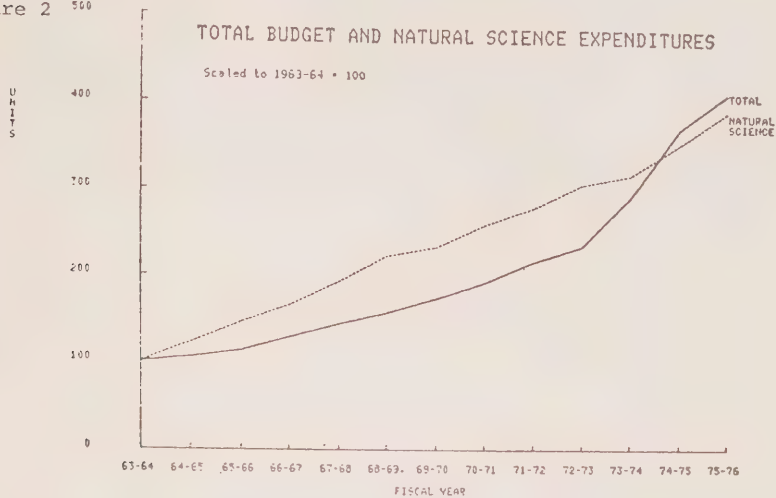
- Is the decline primarily due to a decrease in the growth rate of science or an increase in the growth rate of non-scientific expenditures?

- What do the "real" growth curves of the total and natural science expenditures look like when allowance is made for inflation?

* Data for all graphs are presented in summary tables in the appendix.

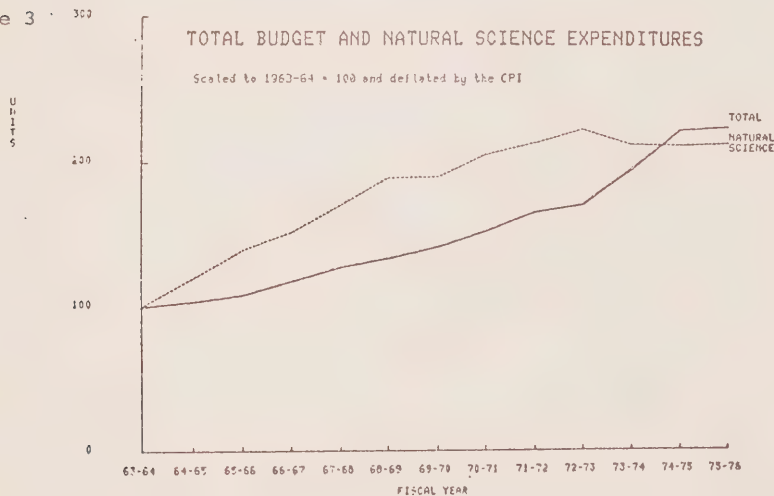
In order to compare growth curves of total and natural science expenditures, it is necessary to let their 1963-64 values (total \$6,872M, natural science \$301M) form a base year, arbitrarily defined as 100 units. The resulting graph, Figure 2, provides an answer to the first question on the previous page by showing that expenditures in the natural sciences have increased at a very regular rate since 1963-64. Their decline relative to the total budget is due to a sharp increase in non-scientific expenditures beginning in 1973-74.

Figure 2



A comparison of the "real" growths of total budget and natural science expenditures is provided by Figure 3, in which the Consumer Price Index has been used to deflate the data of Figure 2. The illustrated increases to 224% of the 1963-64 value for total budget expenditures and to 213% for the natural sciences are approximations of their real growths after allowance is made for inflation. Scientific expenditures have remained roughly constant since 1971-72 (213% of 1963-64 after deflation by the CPI) while the total budget has experienced a real growth of 36% (after deflation by the CPI) over the same period.

Figure 3



The Framework

Having shown that the decline in natural science expenditures as a proportion of the total budget is due to a sharp (36% after allowing for inflation) increase in non-scientific expenditures since 1971-72, we shall now examine various break-downs of the total budget seeking an explanation for the increase. This examination will provide us with a framework permitting a more detailed comparison of scientific and total budget expenditures.

The growth of statutory expenditures can be seen from Figures 4 and 5 to have been about the same as that of voted expenditures from 1963-64 to 1967-68 but markedly faster than total expenditures from then to 1971-72. Since that time, the two expenditure curves have grown at about the same rate. Both of these elements of the budget must therefore contribute about equally to the sharp post-1971-72 growth in non-science spending and therefore such a breakdown does not shed any light on the reason for the relative decline of science spending since 1968-69.

Figure 4

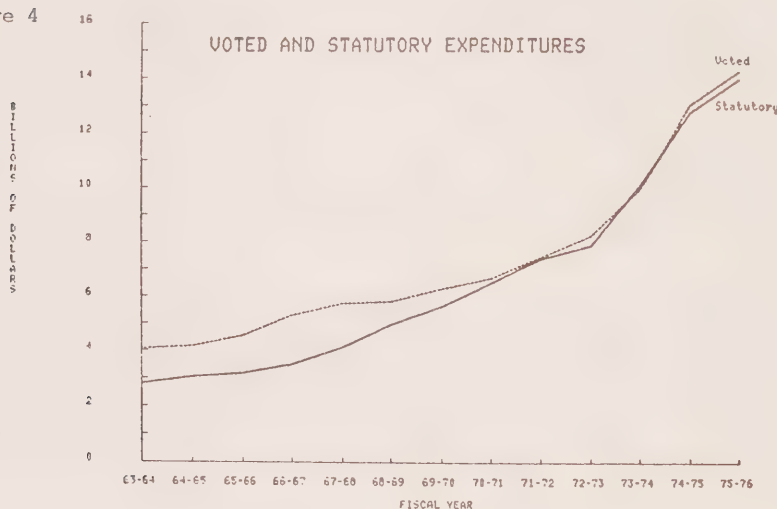
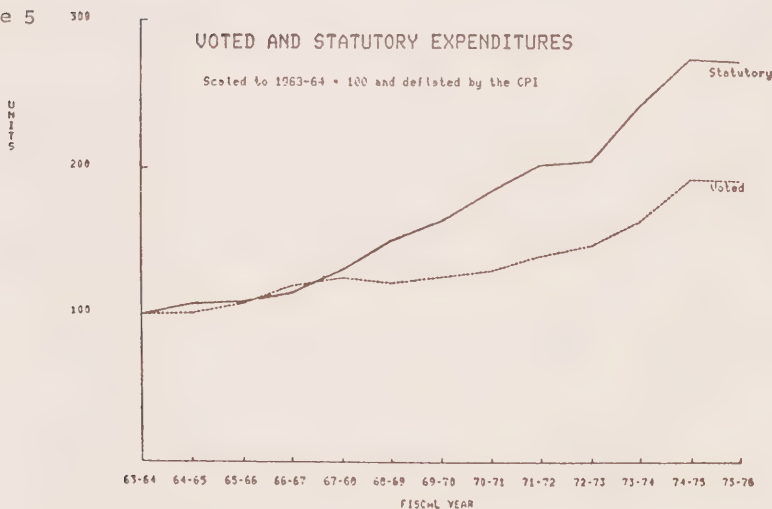


Figure 5



Although scientific expenditures are included in most of the budgetary functions, an examination of Figures 6 and 7 shows that the function "Fiscal Transfer Payments to Provinces" ("5") which contains no science expenditures, is a moderately large item (Figure 6) and demonstrates by far the largest growth (Figure 7). During the period 1971-72 to 1975-76, these expenditures increased 31% (after allowing for inflation) and will thus have contributed to the recent surge in non-scientific spending. The \$1.2B increase involved, however, represents less than 10% of the overall budget's growth. The remaining 90% of this overall budget growth is distributed throughout the remaining functions in a manner which reveals nothing about the reason for the relative decline of their respective scientific components.

Figure 6

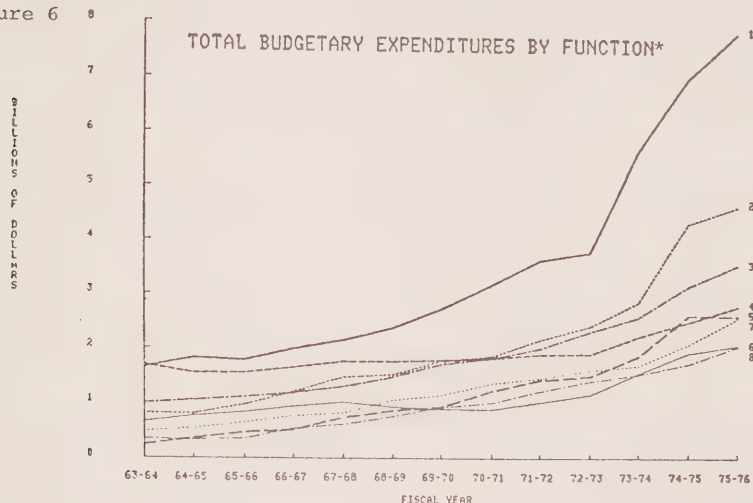
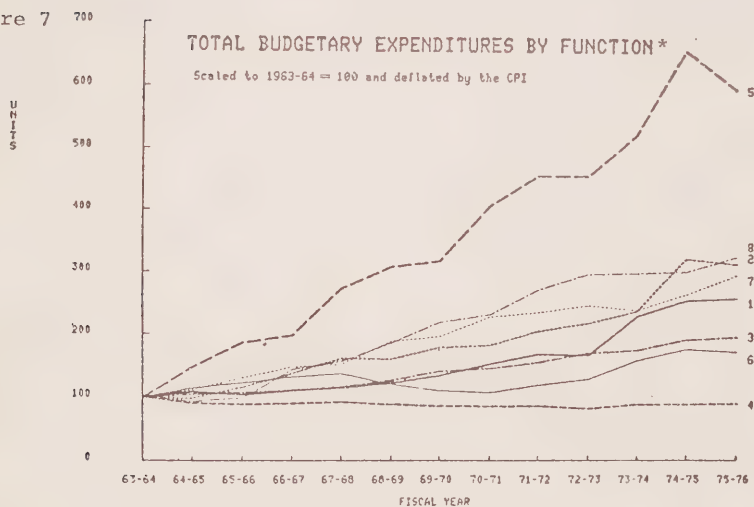


Figure 7



- | | |
|---|-------------------------------------|
| * 1 - Health & Welfare | 2 - Economic Dev. & Support |
| 3 - Public Debt | 4 - Defence |
| 5 - Fiscal Transfer Payments to Provinces | 6 - Transportation & Communications |
| 7 - General Government Services & Internal Overhead | 8 - Other |

Consideration of the fact that Fiscal Transfer Payments are included in Standard Object of Expenditure Number 10 in the Estimates in combination with Grants and Contributions led to the selection of the breakdown by "Types of Expenditure" illustrated in Figures 8 and 9. These graphs reveal that Grants, Contributions and Other Transfer Payments have shown an increase of 47% since 1971-72 (after allowing for inflation) as compared with only 23% for Operating Expenditures, the other major item. Not only does this increase of \$7.4B account for more than half of the total increase in the federal budget over this period, but it also contains virtually no science expenditures, being chiefly made up of increases in such statutory items as health and welfare contributions, fiscal transfer payments and unemployment insurance contributions (as well as the similar but non-statutory oil transfer payments). The implications of this situation will be discussed in the following section, which will use this breakdown as a framework on which to base a comparison of total and scientific expenditures.

Figure 8 16

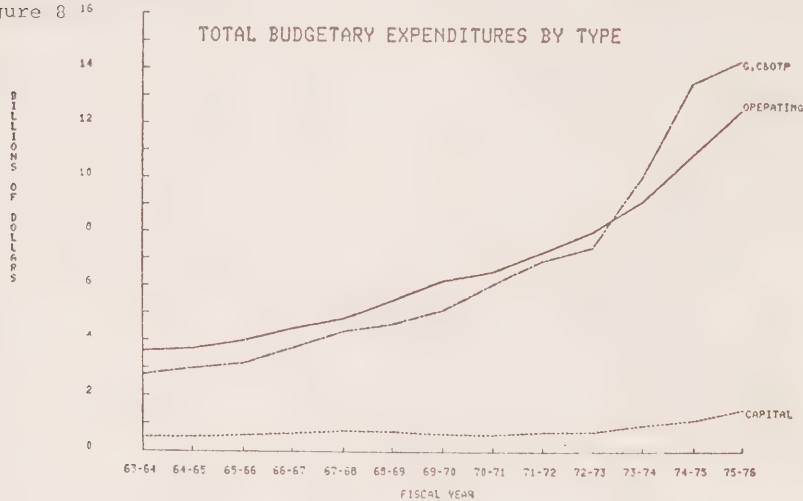
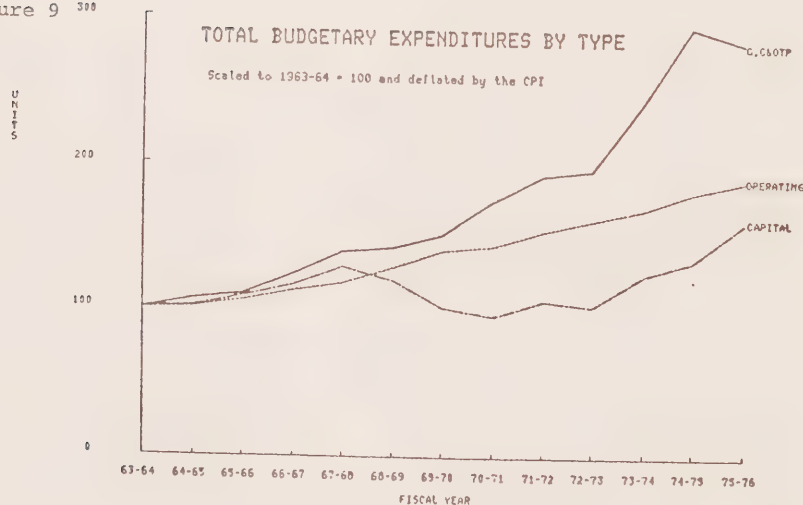
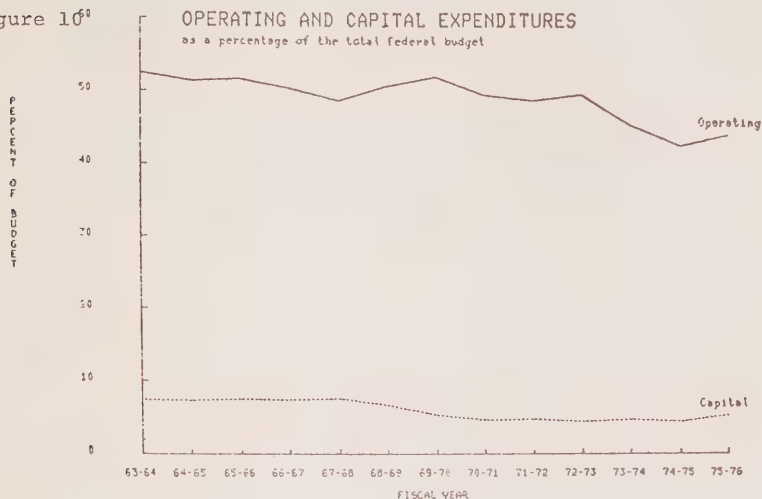


Figure 9 308



The Comparisons

Since we have shown that the recent rapid growth in Grants, Contributor and Other Transfer Payments includes an insignificant amount of science expenditure, we may state that not only science expenditures can be said to be losing ground to the overall budget. In fact, Figure 10 shows that total operating and capital expenditures are also decreasing as a proportion of the budget.

Figure 10⁰

For this reason, it is necessary to compare each type of science expenditure with the corresponding element of the total budget. Fortunately, expenditures on the natural sciences may be broken down in a manner reasonably comparable with the Standard Object of Expenditure classification used in Figures 8 and 9: capital expenditure figures are available; intramural current expenditures are approximately equivalent to the operating expenditures of the total budget; and the remainder, extramural expenditures, is roughly analogous to Grants, Contributions and Other Transfer Payments. Figure 11 presents these expenditures.

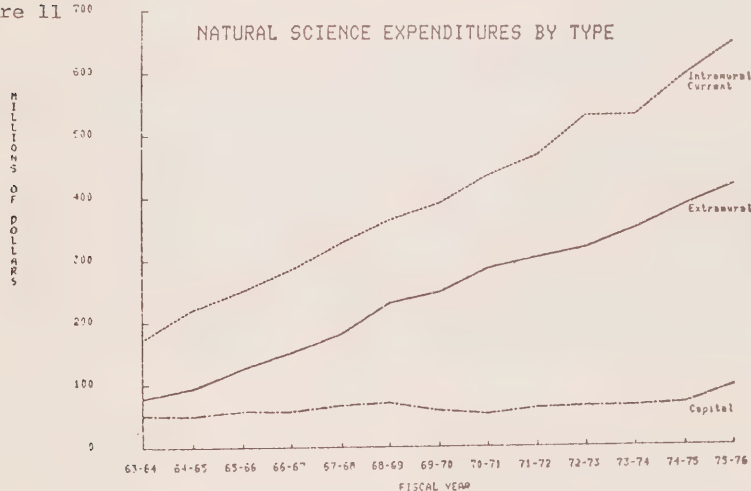
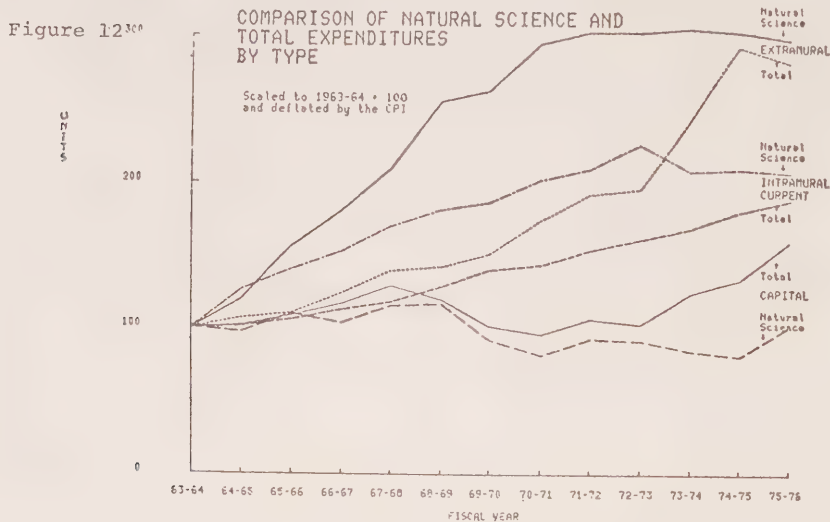
Figure 11⁰⁰

Figure 12 presents the natural science curves of Figure 11 scaled, deflated and compared with the total budget curves of Figure 9.



From this graph, we can make three comparisons:

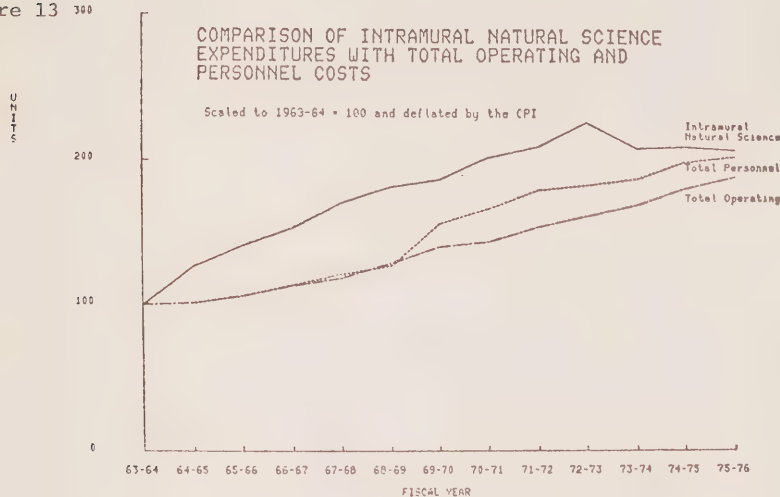
1) Extramural - Extramural expenditures in the natural sciences appear to have grown very rapidly up to 1970-71, but have shown no real growth since then. The sharp recent increase in the "Extramural Total" curve (G, C & OTP) is due almost exclusively to increased Transfer Payments, so that the Grants and Contributions portion analogous to the extramural science expenditures must show the same recent declining growth rate.

2) Capital - Although similar trends can be seen in the total and scientific capital expenditures, it is evident that the latter has recently been regarded as the more discretionary of the two items and has been held to a lower growth rate than the former. It is evident that in times of fiscal restraint, capital expenditures necessary for growth in the operating functions of a department would generally be assigned a higher priority than those for new research facilities.

3) Intramural Current - This pair of lines is probably the most meaningful comparison available. It compares the growth rates of the total operating budget (Intramural total) with that of the in-house governmental scientific establishment. It therefore shows that, up to 1972-73, intramural science was growing more rapidly than the overall federal operating budget. Since that time, a decline has taken place in intramural science, while the total operating expenditures continue a slow, steady, real growth. This may be, in part, due to the influence of the Make or Buy Policy, since the decline in extramural science expenditures is considerably smaller than that in intramural science expenditures. Once again, however, this indicates that scientific expenditures have recently been given a lower priority than expenditures on line operations. In a period of relatively tight budgets, intramural research can not quite manage to keep pace with inflation, while the federal operating expenditures continue their regular increase.

One final graph (Figure 13) is included to deal with a possible objection to the comparison of scientific and non-scientific operating expenditures. Since it is probable that scientific operating costs contain a larger personnel component than do non-scientific operating costs, Standard Object of Expenditure Number 1 (Salaries, Wages and Other Personnel Costs) is included in the comparison. Even if one assumed the extreme case that all scientific operating costs were personnel costs and compared the upper two lines one is left with the same final conclusion: having been favoured over general operating costs up to 1972-73, intramural science is declining toward (but has not yet reached) a real growth relative to the base year 1963-64 equal to that of total federal operating expenditures.

Figure 13 390



Appendix...1

FEDERAL EXPENDITURES ON THE NATURAL SCIENCES*

1) In Millions of Current Dollars

	INTRAMURAL		EXTRAMURAL	TOTAL
	CURRENT	CAPITAL		
1963-64	172.1	50.8	77.7	300.6
1964-65	220.9	50.1	94.5	365.5
1965-66	251.9	58.2	126.6	436.7
1966-67	285.9	57.3	152.7	495.9
1967-68	329.5	66.1	183.0	578.6
1968-69	366.2	69.7	232.5	668.4
1969-70	393.0	57.3	249.7	700.0
1970-71	437.2	52.1	288.1	777.4
1971-72	469.4	61.3	306.2	836.9
1972-73	533.8	63.7	322.5	920.0
1973-74	535.2	64.1	353.7	953.0
1974-75	601.2	68.6	392.1	1061.9
1975-76	654.5	95.4	424.2	1174.1

2) Scaled to 1963-64 equals 100 units

1963-64	100.0	100.0	100.0	100.0
1964-65	128.4	98.6	121.6	121.6
1965-66	146.4	114.6	162.9	145.3
1966-67	166.1	112.8	196.5	165.0
1967-68	191.5	130.1	235.5	192.5
1968-69	212.8	137.2	299.2	222.4
1969-70	228.4	112.8	321.4	232.9
1970-71	254.0	102.6	370.8	258.6
1971-72	272.7	120.7	394.1	278.4
1972-73	310.2	125.4	415.1	306.1
1973-74	311.0	126.2	455.2	317.0
1974-75	349.3	135.0	504.6	353.3
1975-76	380.3	187.8	545.9	390.6

3) Scaled and deflated by the Consumer Price Index

1963-64	100.0	100.0	100.0	100.0
1964-65	126.4	97.1	119.8	119.7
1965-66	140.4	109.9	156.3	139.3
1966-67	152.7	103.7	180.6	151.6
1967-68	169.9	115.5	209.0	170.8
1968-69	181.2	116.9	254.9	189.4
1969-70	186.2	92.0	262.1	189.9
1970-71	201.6	81.4	294.2	205.2
1971-72	209.1	92.5	302.1	213.4
1972-73	225.9	91.3	302.2	222.9
1973-74	208.4	84.6	305.0	212.5
1974-75	209.8	81.1	303.0	212.1
1975-76	207.6	102.5	298.1	213.2

* Data from the Statistics Canada historical series

Appendix...2

FEDERAL BUDGETARY EXPENDITURES*

1) In Millions of Current Dollars

	VOTED	STATUTORY	OPERATING	CAPITAL	GC&OT†	PERSONNEL	TOTAL
1963-64	4,067	2,805	3,604	511	2,757	1,539	6,872
1964-65	4,167	3,052	3,703	528	2,987	1,578	7,210
1965-66	4,554	3,181	3,985	580	3,171	1,696	7,735
1966-67	5,291	3,507	4,424	649	3,725	1,901	8,798
1967-68	5,739	4,133	4,798	743	4,331	2,096	9,872
1968-69	5,806	4,961	5,447	719	4,601	2,288	10,767
1969-70	6,282	5,640	6,185	635	5,102	2,941	11,922
1970-71	6,676	6,506	6,514	616	6,052	3,224	13,182
1971-72	7,453	7,388	7,226	708	6,907	3,600	14,841
1972-73	8,242	7,879	7,986	722	7,413	3,863	16,121
1973-74	9,949	10,090	9,102	949	9,988	4,302	20,039
1974-75	13,052	12,778	10,850	1,139	13,456	5,106	25,453
1975-76	14,265	13,977	12,471	1,502	14,269	5,723	28,242

2) Scaled to 1963-64 equals 100 units

1963-64	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1964-65	102.5	108.8	102.7	103.4	108.3	102.5	105.0
1965-66	112.0	113.4	110.6	113.4	115.0	110.2	112.6
1966-67	130.1	125.0	122.7	127.1	135.1	123.5	128.0
1967-68	141.1	147.3	133.1	145.5	157.1	136.2	143.7
1968-69	142.8	176.9	151.1	140.8	166.9	148.7	156.7
1969-70	154.5	201.1	171.6	124.4	185.1	191.1	173.5
1970-71	164.2	231.9	180.7	120.6	219.5	209.5	191.8
1971-72	183.3	263.4	200.5	138.6	250.5	233.9	216.0
1972-73	202.7	280.9	221.6	141.3	268.9	251.0	234.6
1973-74	244.6	359.7	252.5	185.8	362.3	279.5	291.6
1974-75	320.9	455.5	301.3	223.0	488.1	331.8	370.4
1975-76	350.7	498.3	346.0	294.0	517.6	371.9	411.0

3) Scaled and deflated by the Consumer Price Index

1963-64	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1964-65	100.9	107.1	101.2	101.8	106.7	101.0	103.4
1965-66	107.4	108.8	106.0	108.8	110.3	105.7	108.0
1966-67	119.6	114.9	112.8	116.8	124.2	113.5	117.7
1967-68	125.2	130.8	118.2	129.1	139.4	120.9	127.5
1968-69	121.6	150.6	128.7	119.9	142.1	126.6	133.4
1969-70	126.0	164.0	139.9	101.4	150.9	155.0	141.5
1970-71	130.3	184.1	143.4	95.7	174.2	166.2	152.2
1971-72	140.5	201.9	153.7	106.2	192.0	179.3	165.5
1972-73	147.6	204.5	161.3	102.9	195.8	182.8	170.8
1973-74	163.9	241.1	169.2	124.5	242.8	187.3	195.4
1974-75	192.7	273.5	180.9	133.9	293.1	199.2	222.4
1975-76	191.5	272.0	188.9	160.5	282.6	203.0	224.4

† Grants, Contributions and Other Transfer Payments

* Data from Public Accounts up to 1973-74, subsequent years from 1975-76 Main Estimates.

Appendix...3

FEDERAL BUDGETARY EXPENDITURES*BY FUNCTION[†]

1) In Millions of Current Dollars

	H&W	ED&S	PD	DEF	FTPP	T&C	CGS&IOE	OTHER
1963-64	1,656	810	994	1,691	240	658	477	346
1964-65	1,824	805	1,051	1,550	350	763	539	328
1965-66	1,786	975	1,111	1,556	466	839	647	355
1966-67	1,994	1,205	1,191	1,651	515	941	763	538
1967-68	2,154	1,473	1,301	1,760	738	1,018	817	611
1968-69	2,384	1,527	1,480	1,762	867	932	1,057	758
1969-70	2,734	1,777	1,717	1,792	932	893	1,148	929
1970-71	3,182	1,862	1,823	1,821	1,229	890	1,367	1,008
1971-72	3,633	2,167	2,010	1,898	1,426	1,023	1,461	1,223
1972-73	3,789	2,419	2,321	1,908	1,501	1,164	1,612	1,407
1973-74	5,674	2,870	2,592	2,236	1,874	1,556	1,699	1,538
1974-75	7,023	4,342	3,175	2,512	2,631	1,934	2,101	1,735
1975-76	7,854	4,657	3,575	2,802	2,625	2,080	2,586	2,063

2) Scaled to 1963-64 equals 100 units

1963-64	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1964-65	110.1	99.4	105.7	91.7	149.2	116.0	113.0	94.8
1965-66	107.9	120.4	111.8	92.0	194.2	127.5	135.6	102.6
1966-67	120.4	148.8	119.8	97.6	214.6	143.0	160.0	155.5
1967-68	130.1	181.9	130.9	104.1	307.5	154.7	171.3	176.6
1968-69	144.0	188.5	148.9	104.2	361.2	141.6	221.6	219.1
1969-70	165.1	219.4	172.7	106.0	388.3	135.7	240.7	268.5
1970-71	192.1	229.9	183.4	107.7	512.1	135.3	286.6	291.3
1971-72	219.4	267.5	202.2	112.2	594.2	155.6	306.3	353.5
1972-73	228.8	298.6	233.5	112.8	625.4	176.9	337.9	406.6
1973-74	342.6	354.3	260.8	132.2	780.8	236.5	356.2	444.5
1974-75	424.1	536.0	319.4	148.6	1096.2	293.9	440.5	501.4
1975-76	474.3	574.9	359.7	165.7	1093.8	316.1	542.1	596.2

3) Scaled and deflated by the Consumer Price Index

1963-64	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1964-65	108.5	97.9	104.1	90.3	146.9	114.2	111.3	93.4
1965-66	103.4	115.5	107.2	88.3	186.2	122.3	130.1	98.4
1966-67	110.7	136.7	110.1	89.7	197.2	131.4	147.0	142.9
1967-68	115.4	161.4	116.2	92.4	272.9	137.3	152.0	156.7
1968-69	122.6	160.6	126.8	88.7	307.7	120.6	188.7	186.6
1969-70	134.6	178.9	140.9	86.4	316.7	110.7	196.3	218.9
1970-71	152.5	182.4	145.5	85.5	406.4	107.3	227.4	231.2
1971-72	168.2	205.1	155.0	86.0	455.4	119.2	234.8	270.9
1972-73	166.6	217.5	170.0	82.2	455.4	128.8	246.1	296.1
1973-74	229.6	237.4	174.7	88.6	523.3	150.5	238.7	297.9
1974-75	254.7	321.9	191.8	89.2	658.3	176.5	264.5	301.1
1975-76	258.9	313.9	196.3	90.5	597.1	172.6	296.0	325.5

* Data from Public Accounts up to 1973-74, subsequent years from 1975-76 Main Estimates.

[†] For full names of functions, see footnote on page 4 of the text.

APPENDIX "12"

Distribution of National R&D Expenditures
by Sectors of Performance and Country,
1967 and 1971

1967
(Percentages)

	Business Enterprise	Government	Higher Education	Private Non-Profit
Switzerland	76.5	6.3	17.1	-
Sweden	69.9	14.2	15.5	0.4
U.S.A.	69.8	14.5	12.2	3.6
Germany	68.2	5.1	16.3	10.4
Belgium	66.8	10.4	21.4	1.3
U.K.	64.9	24.8	7.8	2.5
Japan	62.5	13.0	22.9	1.6
Netherlands	58.1	2.7	17.7	21.5
France	54.2	32.1	12.9	0.8
Canada	37.7	35.6		26.7

Source: OECD Document DAS/SPR/70.43, Table IV

Note: Figures may not add to 100.0% because of rounding.

1971
(Percentages)

	Business Enterprise	Government	Higher Education	Private Non-Profit
Switzerland	77.7	8.3	14.0	-
Germany	67.4	10.4	19.1	3.1
Japan	66.5	13.5	18.6	1.4
U.S.A.	66.5	15.9	13.8	3.9
Sweden	64.7	12.2	23.0	0.1
U.K. (1970)	64.5	24.3	8.4	2.8
Netherlands	60.3	17.6	20.4	1.7
Belgium	56.7	13.1	29.7	0.5
France	56.0	28.1	14.8	1.1
Canada	37.6	35.2		27.3

Source: OECD Document DAS/SPR/74.46, Table 1.2(B)

Note: Figures may not add to 100.0% because of rounding

APPENDIX "13"

Comparison of Federal Government Costs for
Science, R&D, and Mission-Oriented R&D

1. Statcan data shows that the federal budget for all scientific activities (research and development, and related scientific activities, both human and natural sciences) increased from \$914.2 million in 1970-71 to \$1528.1 million in 1975-76. The Canadian industry share decreased from 17.0% to 13.8% in this period (Table 1, item A).
2. The Statcan data includes an estimate of the cost of administration of extramural programs, and differs by this amount from the data published in "How Your Tax Dollar Is Spent 1975-76", which the Senate Committee used as a source in its hearings on December 3.
3. The federal budget for R&D (both human and natural sciences) increased from \$629.8 million in 1970-71 to \$997.6 million in 1975-76. The industrial share decreased from 23.2% to 19.8% (Table 1, item B).

During this period there was a decrease in the industrial assistance programs (PAIT, DIP, IRAP, DIR, IRDIA) from \$134.8 million to \$126.0 million together with an increase in contracts from \$11.3 million to \$71.6 million. Intramural R&D grew faster than payments to industry.

4. The federal budget for R&D covered by the Make or Buy policy (mission-oriented R&D in the natural sciences for Schedule A and B departments and agencies) increased from \$240.0 million in 1970-71 to \$381.4 million in 1975-76. The industrial share increased from \$10.6 million (4.4%) to \$49.1 million (12.9%). See Table 1, item C.
5. Table 2 gives more detail on the trends in R&D covered by the Make or Buy policy (mission-oriented R&D in the natural sciences financed by Schedule A and B corporations) for each year from 1970-71 to 1975-76.

Program Review and Assessment Division

December 15, 1975

TABLE 1

Federal Government Costs for Sciences, R&D and Mission-Oriented R&D

	1970-71		1975-76		Comments
	\$M	%	\$M	%	
A All Scientific Activities:					
Intramural	537.4	64.2	1,000.3	65.4	Intramural costs include the cost of administering extramural programs (A.E.P.)
Canadian Industries	155.0	17.0	211.6	13.8	
Canadian Universities and N.P.O.	159.2	17.4	228.2	14.9	
Others	12.6	1.4	87.8	5.7	
TOTAL	914.2	100.0	1,528.1	100.0	
B R&D					
Intramural	341.4	54.2	557.9	55.9	Excludes the Related Scientific Activities
Canadian Industries					
- Grants	134.8*	21.4	126.0	12.6	
- Contracts	11.3*	1.8	71.6	7.2	
Total	146.2	23.2	197.6	19.8	
Canadian Universities and N.P.O.	136.2	21.6	188.3	18.9	
Others	6.6	1.0	53.7	5.4	
TOTAL	629.8	100.0	997.6	100.0	
C Mission-Oriented R&D in Natural Sciences Schedule A and B Departments and Agencies					
Intramural Current	223.6	93.1	317.3	83.2	Excludes: Human Sciences R.S.A. (except feasibility studies) Grants and extramural research fellowships Free Basic Research and A.E.P.
Canadian Industries	10.6	4.4	49.1	12.9	
Canadian Universities and N.P.O.	2.4	1.0	7.8	2.0	
Others	3.4	1.4	7.1	1.8	
TOTAL	240.0	100.0	381.4	100.0	

* Statistics Canada Estimate

TABLE 2

SHORT-TERM SERIES ON
INTRAMURAL & CONTRACT EXPENDITURES FOR MISSION-ORIENTED R&D
IN THE NATURAL SCIENCES (\$000)
(Schedules A and B - Departments and Agencies)

	CURRENT INTRAMURAL	MISSION-ORIENTED R&D CONTRACTS			TOTAL	PERCENTAGES			
		Industry	Univ. & NP/s	Other		Intramural	Industry*	University	Other
	Mission-Oriented R&D Expenditures								
1970-71	223,600	10,594	2,452	3,400	240,046	93.1	4.4	1.0	1.5
1971-72	234,826	14,491	2,644	2,076	254,037	92.4	5.7	1.0	0.8
1972-73	254,544	19,772	4,078	4,109	282,503	90.1	7.0	1.4	1.5
1973-74	267,720	29,483	4,240	3,807	305,250	87.7	9.7	1.4	1.2
1974-75	291,943	34,482	5,581	7,473	339,479	86	10.2	1.6	2.2
1975-76	317,334	49,133	7,811	7,087	381,365	83.2	12.9	2.0	1.9

* Canadian Industry

SOURCE: Statistics Canada Special Tabulation, October 6, 1975. (See Appendix A, Tables I, II, III, IV).



FIRST SESSION—THIRTIETH PARLIAMENT

1974-75-76

THE SENATE OF CANADA
PROCEEDINGS OF THE
SPECIAL COMMITTEE OF THE SENATE ON
SCIENCE POLICY

The Honourable MAURICE LAMONTAGNE, P.C., *Chairman*

Issue No. 3

WEDNESDAY, FEBRUARY 11, 1976

Third Proceedings on
The Study of Canadian Government and other
expenditures on scientific activities
and matters related thereto.

(Witnesses: See Minutes of Proceedings)



THE SPECIAL COMMITTEE OF THE
SENATE ON SCIENCE POLICY

The Honourable Maurice Lamontagne, P.C., *Chairman*

The Honourable Donald Cameron, *Deputy Chairman*

and

The Honourable Senators:

Asselin	Hastings
Bélisle	Hicks
Bell	Lang
Blois	Manning
Bonnell	Neiman
Bourget	Riel
Buckwold	Robichaud
Carter	Rowe
Giguère	Stanbury
Godfrey	Thompson
Goldenburg	van Roggen
Grosart	Yuzyk
Haig	

27 Members

(Quorum 5)

Order of Reference

Extract from the First Report of the Special Committee of the Senate on Science Policy, presented on July 10, 1975 and printed as an Appendix to the Minutes of the Proceedings of the Senate of that day, and adopted by the Senate on July 24, 1975:

"The Committee, therefore, recommends that it be authorized to consider and report on Canadian government and other expenditures on scientific activities and matters related thereto;

That the Committee have power to engage the services of such counsel and clerical personnel as may be necessary for the purpose of the inquiry;

That the Committee have power to send for persons, papers and records, to sit during adjournments of the Senate and to report from time to time; and

That the Committee be authorized to print such papers and evidence from day to day as may be ordered by the Committee."

Robert Fortier,
Clerk of the Senate.

Minutes of Proceedings

Wednesday, February 11, 1976

(10)

Pursuant to adjournment and notice, the Special Committee of the Senate on Science Policy met this day at 4:13 p.m., the Chairman, the Honourable Senator Lamontagne, presiding.

Present: The Honourable Senators Bell, Bonnell, Carter, Giguère, Godfrey, Lamontagne, Manning, Neiman, Rowe and Yuzyk. (10)

In attendance: Messrs. Philip J. Pocock, Director of Research, and Jacques W. Ostiguy, Chief of Administration.

The Committee resumed consideration of its Order of Reference dated July 24, 1975 relating to the study of Canadian Government and other expenditures on scientific activities and matters related thereto.

The Chairman made an opening statement.

The following witnesses were heard:

Dr. M. J. LeClair,
Secretary of the Ministry of State for Science and Technology;

Mrs. L. M. Thur,
Senior Assistant Secretary, (*University Branch*),
Ministry of State for Science and Technology;

Mr. Jim Mullin,
General Director,
International Division,
Ministry of State for Science and Technology.

Dr. LeClair made a short opening statement. The witnesses then answered questions put to them by members of the Committee.

At 5:55 p.m. the Committee adjourned to the call of the Chairman.

ATTEST:

Patrick J. Savoie,
Clerk of the Committee.

The Special Senate Committee on Science Policy

Evidence

Ottawa, Wednesday, February 11, 1976.

The Special Committee of the Senate on Science Policy met this day at 4.13 p.m. to consider Canadian Government and other expenditures on scientific activities and matters relating thereto.

Senator Maurice Lamontagne (*Chairman*) in the Chair.

The Chairman: Honourable senators, on your behalf I would like to ask the indulgence of our guest for our being late this afternoon, but the Senate sat rather longer than was expected. This is the only reason for the delay. The Minister, Mr. Drury, could not be with us today, but we have the pleasure of having with us the Secretary of the Ministry of State for Science and Technology, Dr. M. J. LeClair, and his colleagues.

When we met last time, on December 16, we concentrated our examination of the brief more particularly on MOSST's role in the process related to the preparation and approval of the so-called science budget. We had intended to deal today with industrial research and development and government assistance in this area, but in the absence of the minister I do not believe we should discuss this topic today because of its obvious and important policy implications. I propose therefore that we devote our attention today to other parts of the brief, beginning with the subsection entitled, "MOSST's Responsibilities in Relation to International Affairs" which begins at page 14 of the brief and covers most of page 15.

I understand that Dr. LeClair would like to make a short statement on this section of the brief, and then the meeting will be open for discussion and questions.

Dr. M. J. LeClair, Secretary of the Ministry of State for Science and Technology: Mr. Chairman and honourable senators, first of all I would like to express the regrets of the minister who was called to an unscheduled meeting this afternoon and could not be here, but he is looking forward to being here at your next session.

Rather than rewording or summarizing what is already in the brief, perhaps I might take a few minutes to let you know the development framework in the international field and, more specifically, the relationships and the responsibilities of both the Department of External Affairs and the Ministry of State for Science and Technology.

The main forum for discussing and arriving at a Canadian position on international affairs is the Interdepartmental Committee on International Scientific and Technological Relations. This is a fairly new interdepartmental committee, and it is chaired by External Affairs, but MOSST does play an important role. MOSST is not only a member of the main committee, but is also a member of most of the subcommittees.

The goal of the ministry here is to assist External Affairs in preparing the Canadian position and in assisting in any

other way we can, somewhat analogous to the way MOSST perceives its role vis-à-vis other departments in the federal government. If I might express it this way: here we have a staff role rather than a line role, the line role being that of the External Affairs department.

In the field of multilateral activities, MOSST will often chair the interdepartmental consultations before an important meeting, especially those where the area of interest is mostly science and technology—for example, the CSTP of OECD, the NATO Science Committee, or the Commonwealth Science Council. However, the interdepartmental consultations are chaired by External Affairs when talking about agencies that are part of the UN family—such as UNCTAD, the Economic Commission for Europe, and so forth, but here again MOSST plays an active role and occasionally may lead delegations to meetings where most of the agenda is devoted to science and technology. In the field of bilateral co-operation, External Affairs will assume responsibility for organizing and co-ordinating Canada's participation in formal activities, and where it is thought that foreign policy is paramount External Affairs will chair the delegation. If the meeting, again in the bilateral field, is mostly science and technology, then MOSST will go ahead. At this time we have intensive relationships of a formal or semi-formal nature with six countries. With France, Belgium, the Federal Republic of Germany, and the U.S.S.R. we have formal agreements in science and technology, occasionally by themselves or occasionally as part of a general accord. With China and Japan we have working relationships; they are not necessarily signed documents, but we are quite active there as well without necessarily having signed documents.

You will notice that there are two countries which have not been mentioned here with which we have no formal agreements of an umbrella nature, and perhaps these are the two countries where we have more in terms of exchange than with any others; and here I refer to the U.S.A. and the United Kingdom. In general we might say that we prefer not to have so-called umbrella agreements and then look for a substance later. We would rather, perhaps, identify specific areas of collaboration, look at a co-operative program, and then finally negotiate a basic agreement for that area rather than going the other way around, with an accord and then trying to see what you can do under that formal accord.

If I may take, for example, a point alluded to at the last meeting of this committee, our relationships with the U.S., where we have no formal accord covering science and technology we still in the field of science and technology have 21 formal treaties and agreements, but they are specific and not of a general nature. We have 42 joint boards and commissions, not including the 30 under the IJC. We have 63 co-operative R&D programs; 35 information and data exchange programs; and 14 joint use of scientific facilities—not including, of course, hundreds and perhaps

thousands of exchanges between the different scientists. For example, Mr. Chairman, we have here a compilation of the known exchange we have with the U.S.A. They are described here and the description takes 80 pages, so this gives you an idea of how extensive our exchange in the fields of science and technology is with the U.S. Again, this is done without an umbrella type of accord. We are also finding, in the case of one country in particular where we have a formal accord, that as we gain experience and have more exchange the formal accord or entente in itself becomes meaningless. Once the impetus has been given to these exchanges, if they are good and worthwhile we find that they go ahead by themselves without having the stimulus of a formal accord.

Mr. Chairman, that concludes my preliminary remarks. We would, of course, be glad to endeavour to answer any questions you may have.

The Chairman: Thank you very much, Dr. LeClair. Who will start the questioning?

Senator Carter: I will begin. You say at the bottom of page 14 that "our policies in science and technology must take account of what is happening elsewhere." Then you have told us that you have an interdepartmental committee and eight counsellors abroad. That was when the brief was prepared. Has there been any change in the number of counsellors?

Dr. LeClair: No, not yet. I could give you the list of the eight, if you wish, not necessarily in order of importance: one in Brussels; one in Paris; one in Tokyo; one in London; one in Washington; one in Bonn; one at the OECD; and the eighth is the environmental counsellor in Washington.

Senator Carter: Those are all MOSST counsellors, are they not?

Dr. LeClair: No, they are not necessarily from MOSST; they come from various departments. Two are from MOSST; one is from Communications; one from Treasury Board; one from EMR; one from DRB; and one is from External Affairs. They are all looked upon as officers of External Affairs while they are abroad.

Senator Carter: Could you tell us how these counsellors operate? What do they do?

Dr. LeClair: I believe Mr. Mullin could answer that better than I.

Mr. J. Mullin, General Director, International Division, Ministry of State for Science and Technology: Mr. Chairman, the science counsellors overseas are, in effect, intelligence officers, whose job it is to be familiar with the structure of science and science policy in the area to which they are accredited. It is their job to become acquainted with the programs in science and technology, the priorities in science and technology and the opportunities for Canadian participation in joint programs. They then report back. They do their work partially on their own initiative, based upon the knowledge they acquire through living in the various capitals, and partially in response to requests sent by MOSST, External Affairs, or any of the departments of government having a particular interest or having particularly close liaison with a foreign department at any given time. For example, not many months ago the science counsellor in Washington was doing much work for Energy, Mines and Resources as the U.S. moved to create the ERDA agency. He was, in effect, for a period of months,

devoting most of his time in trying to understand which new directions U.S. energy priorities are likely to take. The priorities on his time will shift as other departments have more pressing material to send out, where discussions may have shifted to remote centres. His work on site is therefore programmed partly by his finding out what is going on and trying to promote interest in Canada and partly by acting as an agent for science and technology based departments in Ottawa when specific requests are sent out.

Senator Carter: How long have these eight counsellors been posted? Did that take place in recent years?

Mr. Mullin: The first positions, I believe, date back many years in Washington and London, and later in Paris and OECD. The recent ones were Brussels and Bonn, which were only created about four years ago. The counsellor in Tokyo was appointed only three years ago. The environmental counsellor was first appointed in Washington less than a year ago. However, there has been a small group of science counsellors overseas for 15 or 20 years in two or three capitals, and over the last five years there has been a slow growth.

Senator Carter: These counsellors promote the exchanges of scientific and technological knowledge and information. Do they do anything more, such as promoting joint projects between Canada and the U.S., and spotting joint projects in which Canada might be interested?

Mr. Mullin: They try to do this and particularly in cases in which there have been formal accords which in the past have usually been undertaken in areas in which we deliberately wish to increase the amount of scientific activity. The counsellor on the ground will attempt to keep the departments in Ottawa aware of opportunities and send back information which should lead Ottawa to develop proposals. He will take knowledge of what the Ottawa-based departments are interested in and attempt to match up interest in other countries. From this point of view the counsellors in Brussels and Bonn are very much involved in bringing groups together who are trying for the first time to mount collaborative programs.

The Chairman: But they are mainly trying to keep liaison with governments.

Mr. Mullin: Principally with governments, yes.

The Chairman: And they are not devoting too much time to trying to find out what the new technological developments in industry are in those countries, for instance?

Mr. Mullin: They will report on industrial developments and will devote as much of their time as they have, free from other requests. Many of the requests from Ottawa departments will be to look at industrial developments, but when it comes to promoting particular collaborative experiments, to date it has largely been from government to government, but the information collected has covered a wider spectrum.

The Chairman: What is the professional background of the counsellors? Are they scientists, engineers?

Mr. Mullin: They are a mixture; most have had experience in government science or technology. Some of them have been pure scientist. The counsellor in Tokyo, for example, was an experimental nuclear physicist; the man in London however, was an engineer; and the man in

Washington is an engineer by background. So there is a mixture.

Senator Carter: We have had one in France for how long?

Mr. Mullin: Probably for at least 20 years; I am very inexact about the dates.

Senator Carter: I am thinking about our oceans policy, with respect to which Mr. Drury told us about our new policy which has been in effect since MOSST has come into being. I wonder how it is that we are not a partner in the French-American mid-ocean underseas study which is being developed. That is something that would be of tremendous interest to us. How is it that we are not part of that?

Dr. LeClair: Mr. Chairman, it is true that we are not a part of that formal agreement, but oceanography in particular has been a rather successful field of co-operation between France and Canada. More specifically to answer your question, sir, there have been people sent very recently from EMR to France, in particular to Centre National des Explorations des Océans, their exploration centre. There are also possibilities between EMR and France to consider what participation we could have. Also, of course, there has been some involvement of Canadian companies in this, as well as government.

The Chairman: There has been no discussion at any time as to our participation, for instance, in project FAMOUS?

Dr. LeClair: There might have been discussions but I do not believe they were very serious and they did not lead, certainly, to any formal agreement.

Senator Manning: In the opening statement reference was made to the science committee of NATO and also to the Commonwealth Science Committee. What is Canada's role in those committees, are we actually represented on them, and where are they based?

Mr. Mullin: For the NATO science committee, Canada's member is Doctor Tuzo Wilson, who is currently the director of the Ontario Science Centre and was formerly director of geophysics in the University of Toronto. He was appointed to MOSST during the last year to serve as Canada's member. He sits on the NATO science committee. One of its main functions has been to distribute money to allow for the interchange of scientists among NATO member countries. A second function has been to distribute money for running advanced study institutes. There was an advanced study institute held last summer at Memorial University in Newfoundland on Arctic systems, which brought 60 or so participants from the major NATO countries interested in the North together to look at Arctic systems. This was funded by one of the subcommittees of the NATO science committee. Canada has, I believe since the inception of that committee, been active, both in the main committee and on many of the panels set up to look at progress in specific areas. The Commonwealth Science Council as it is now called, was recently re-formed from the old Commonwealth science committee. Its main interest has been science in the process of development. Canada has been represented at meetings and has taken part in the discussions which have attempted to spread a better understanding of how to successfully apply science and technology in the process of development. The biennial meeting of the Commonwealth Science Council is due to

take place in November-December of this year, in Sri Lanka, where the major topic of discussion will be science in the development of rural infrastructure. There is a possibility that a Canadian expert will be invited to give one of the leading papers there.

Senator Manning: Are those committees entirely of government appointed representatives, or is the private sector involved in any way—industrial scientists, and so on?

Mr. Mullin: Yes. They are government appointed representatives, but in the case of the NATO Science Committee many of the members themselves are academics. Du. Tuzo Wilson is himself mainly an academic. The representative of the United States is Professor Rabi, a well-known physicist and academic. I think, on balance, there are more academics than government scientists on the NATO Science Committee. The formal members of the Commonwealth Science Council are governmental scientists, but they can be accompanied by experts from any sector chosen by the country, and they will be chosen depending upon what the particular topic on the agenda is at the major biennial meetings.

Senator Manning: There is reference made also to quite a number of specific agreements in this field with the United States. How do those agreements come about? Who initiates them? What causes them to be born in the first place?

Mr. Mullin: I suppose nowadays they might be called bottom-up agreements, when scientists working on programs who have a very good understanding of what is going on in the other countries, and who can see advantages, will propose to their colleagues that they participate in a joint project. Sometimes it will go to a higher level, and, where the program is very large, it will be to agency. The proposal that got Canadian participation in the land-sat, the earth resources satellite, was agency to agency. One hopes that scientists are always on the lookout to see how best they can supplement their own efforts by getting into collaborative agreements. In the case of the U.S. it is done on the basis of a particular need being identified. If people say there are colleagues in the U.S. with whom we can profitably collaborate in making a proposal, and provided the other side sees the problem as having a similar priority to the side that is making the proposal, then things get together and usually the exchange of paper comes to when you get down to deciding who is going to pay how much for what.

Senator Manning: It is usually initiated by the scientists themselves?

Mr. Mullin: Yes.

The Chairman: Are there any people participating in those projects coming from industry on both sides, or is this purely an exchange between government people and academics?

Mr. Mullin: The list which Dr. LeClair referred to and for which he gave the number of agreements was specifically government-to-government agreements. We have not even started to try to identify how many agreements of what sort exist in the private sector. The huge number of corporate relationships mean that a lot of exchanges take place inside corporate structures. There may even be a large number of mixed government-industry agreements...

The Chairman: That is what I meant.

Mr. Mullin: —But I do not have an answer on that at the present time.

Senator Carter: May I ask a question I omitted earlier? You have eight counsellors and they send back information. What is the function of this interdepartmental committee?

Mr. Mullin: If I project forward to what I hope will be happier budgetary times, the next time more money comes on the horizon there will be a discussion as to where should the next science counsellor go. One can imagine that one department will know that Sweden has particularly good programs in the area and it would be profitable if they had a science counsellor in that capital, while another department may think that the Dutch have a particular program that they would like to be closer to; and so there will be interdepartmental discussions on where, given some new money, would be best to deploy these resources.

There are also many international meetings that go on regularly from year to year which require Canada to come to some position and decide whether or not we will support their initiative; and the initiatives usually do not fit neatly into the mandate of a single department in Ottawa. So there is a need for a mechanism to decide.

The interdepartmental committee and its sub groups also get into the nitty-gritty of making sure that we are ready and have all the papers necessary for a formal meeting with another country, to make sure that the papers are in reasonable and intelligent form and that everything is in fact ready. So sometimes they deal with relatively small administrative questions.

Senator Carter: But they have little to do with the actual flow of information?

Mr. Mullin: They are not placed as a barrier to the quick flow between the science counsellor and the person with a need for information back in Ottawa, no.

Senator Carter: You have four counsellors attached to MOSST?

Mr. Mullin: No. We have two counsellors who are MOSST staff members who are seconded to EMR and at the end of their period overseas will revert to being staff members of MOSST.

Senator Carter: Who do they report back to? Suppose the fellow in France has picked up a little bit of technology and he relays it back here, where does it go to—to MOSST, or External Affairs?

Mr. Mullin: He will send it directly to the group he considers most interested, and he will send copies to other people who might be peripherally interested.

The Chairman: He will send a copy to External Affairs?

Mr. Mullin: And he will direct copies, perhaps, to Communications. He would, I am sure, not send a single copy. The usual custom is for the counsellor to send a copy for the record, to keep us informed both as to MOSST and External Affairs; but he would also address them to Communications or whoever happened to be involved.

The Chairman: He is allowed to communicate with other departments, but with MOSST in particular?

Mr. Mullin: Yes.

Senator Carter: Suppose that MOSST sees it, either by getting a copy or by direct communication, and finds that here is a new development going on in Belgium, Japan, or somewhere, and that that technology is of tremendous importance to some part of our private sector, what do you people do with it? What happens to it?

Mr. Mullin: I would assume that if it were technological it would have been addressed primarily to someone else, and MOSST would stay on the tail of that "someone else" who should have a detailed contact from the private sector, and we would try to make sure that the information was passed on out of government to wherever it should go. We have good working relations with colleagues in places like Industry, Trade and Commerce, and I am sure that when they receive important information it gets out relatively quickly to the private sector.

Senator Carter: Can you mention any specific case where that sort of thing has happened and where it has been relayed out to private industry?

Mr. LeClair: I could give an example where this has happened. The example in itself is small, but it might elucidate what you are after. This concerns what we were talking about before—the work of CONEXO. In this case it was the science counsellor in Paris who brought me to see them when I was there, and I brought back a pocketful of nodules. We then started to talk to EMR, and in three weeks EMR had sent someone there to find out what they were doing. Since then we have been following this up with EMR to ensure that it has not fallen by the wayside, and in fact there has been a follow-up on the part of EMR. So here is a specific example of where we have done just that, except that the information was relayed directly by me rather than the counsellor. I wish I had one of those nodules to give you, Mr. Chairman. They are very fine to put on your desk.

The Chairman: How long do you expect these counsellors to stay in any given country?

Mr. Mullin: Normally four years.

The Chairman: Not more than that?

Mr. Mullin: Not more than that usually.

The Chairman: Is that because of a regulation coming from External Affairs or from you?

Mr. Mullin: I suppose it is agreed upon by both of us, because after four years or so away the individual begins to lose touch with what is going on in Ottawa. So in the same way that foreign service officers are rotated back into Ottawa, we like to bring people back here. Also many of these people are scientists in mid-career who are interested in giving a relatively short span of their time but who feel they would get pretty remote from the lab and their mainline interest if they stayed more than four years away from whatever is their principal interest.

The Chairman: We had a very interesting experience while in West Germany in 1969. We met a number of people involved in science policy and technology in West Germany at that time, and when we inquired as to an overall picture of the situation in West Germany, particularly in relation to the most important technological developments, we were told by various agencies to see the science attaché of the United States, which we did. He had

been in the post for six years and, in addition, had many years of experience in the United States in industrial research. We found him to be very knowledgeable on the situation in West Germany at that time.

I think it is far better for our science counsellors to be knowledgeable on developments in other countries, as opposed to being in a position to relate Canadian developments to foreign agencies. It is to be expected that our agencies in Canada would be able to relate the information coming from abroad to interested people in Canada. I think perhaps a period of three or four years is not sufficient to cover these very complex areas.

Mr. LeClair: Mr. Chairman, we have some counsellors whose terms exceed four years. For various reasons, they have been given further terms. In relation to those counsellors, we have found, as Mr. Mullin pointed out, that they may lose touch with what is going on in this country. Perhaps it is because we assume that the role of the science counsellor is not only to tell us what is going on in the country to which he or she is assigned, but also to inform the interested parties in that country as to what is going on in Canada.

The Chairman: We should not be interested in telling them what is going on here. We want to keep some secrets, too.

Mr. LeClair: But we are, Mr. Chairman, and I think we should be very interested in relating to them the opportunities in Canada in science and technology. As a matter of fact, we are presently trying to convince the Japanese that Canada is a country that can deliver much more than natural resources; that we have a great deal to offer in the way of technology. Our counsellor in Tokyo at this time is engaged in an effort to convince the Japanese people that Canada is a highly developed nation technologically. That is part of the counsellor's role, as we see it, and something which should be carried out effectively. It would be very difficult for someone who is out of the country for eight to nine years to be able to speak with authority on development in Canada.

Senator Bell: Mr. Chairman, what is presently going on in Great Britain with respect to gas should be of great interest to Canada. They are taking ordinary coal and turning it into pipeline-quality gas. Surely, this is something which Canada as a nation should be interested in? My understanding is that TransCanada Pipeline has a very small investment in that project, and apart from that we have no other interest in it, yet it looks as though tremendous returns will be realized. Is our Science counsellor in Britain in a position to inform Canadians about the worth of this project, or where does that sort of idea originate? I understand TransCanada Pipeline may pull out. It is a small thing without much backing in Canada.

Mr. LeClair: I do not think we can regard this as the responsibility of one person. Taking that particular example, surely that particular counsellor should at least be aware of such projects and should be in constant communication with Canada telling us what is happening. However, in a field as complicated and difficult technologically as the gasification of coal, EMR is the department which would be sending representatives routinely, and perhaps sending people to such projects under various exchange programs, and more than just a visit. These people could be assigned to such projects for a few months, or even a year or two. In addition, some of our universities would be

involved in sending representatives to observe and work on such projects. The responsibility certainly is a divided one.

I agree that the counsellor should be the one alerting us to these developments and should be keeping us informed in terms of follow-up. If, in a case such as this, MOSST was made aware that there was no follow-up, or no adequate representation, then certainly we would take it up with EMR. However, the responsibility of seeing how many people are sent and who sends them, and so forth, would not be ours, but rather that of the interested department.

Mr. Mullin: Both the present and the previous science counsellors to the United Kingdom were very outspoken on behalf of the nuclear program, and they were of considerable assistance in Canada's efforts in persuading the United Kingdom that it should switch to a design comparable to the Canadian model and not the American system. In that respect, their role was to keep Canadians informed, on a very rapid basis, of what changes were going on, who was saying what, who was taking which side in the debate, and to assist those who eventually arrived from Canada to participate in the lengthy discussions that led to Great Britain moving towards a Canadian-style reactor. In that instance, they were taking with them, in part, the detailed knowledge of the Canadian situation, which they might not have had had they been out of the country for eight or nine years.

Senator Bell: The role of the science counsellor, as you see it, then, is one which you will be coordinating with the activities of the various departments, such as EMR, Industry, Trade and Commerce, and so forth.

Dr. LeClair: I would say that is a fair assessment of our role. We are not the only actors involved. The Department of External Affairs is very interested, as is Industry, Trade and Commerce.

Mr. Mullin: Trade commissions also spend a great deal of time in relation to technological developments overseas, so that, in a sense, it is being overly restrictive to think that our representation concerned with science and technology is limited to those holding the title of science counsellor.

The Chairman: Have you given any thought to assigning a science counsellor to a group of related countries, such as Belgium, Holland and Luxembourg? I raise that with the thought in mind that our financial means are rather limited. Why could we not have a science counsellor assigned to Belgium, but who would also be responsible for Holland and Luxembourg?

Dr. LeClair: Mr. Chairman, without divulging any secrets, I would say your question is a very timely one. That is an exercise we are going through at this time.

The Chairman: Are there any other questions on this section?

Senator Carter: Mr. Chairman, I was interested in Mr. Mullin's remarks about our representative in Tokyo trying to enlighten the Japanese as to Canada's technological capabilities. Mr. Mullin's remarks in that respect raise a lot of questions in my mind. The Japanese Embassy in Canada has many intelligent people attached to it. Does it have a science counsellor attached to it? Is our representative in Tokyo trying to persuade private industry in Tokyo that Canada does have some technological capabilities?

Mr. Mullin: First of all, I do not believe anyone in the Japanese Embassy has the title of science counsellor, or has a role similar to that carried out by the people we call science counsellors. However, Japanese trade missions will undoubtedly have things to say. Whether or not their trade missions look at research and development capacities in Canada, I do not know.

As to the second part of your question, the science counsellor attached to the Canadian Embassy in Tokyo most recently has been busy in areas such as space research and looking at the possibility of collaboration in that area. In Canada, a role has been given to the space industry in what is going on through the Department of Communications, so that if, in the long term, the collaboration works out, there will be Canadian industry and Canadian government, with a similar pairing on the other side.

People tend to think of Canada as a resource exporter. They do not necessarily stop and think of how well developed our technology capabilities are.

The Chairman: It seems to me that the Japanese have put a lot of emphasis on certain missions abroad, consisting of their qualified scientists and engineers, and even their industry people. We do not seem to have given that kind of emphasis here, but have relied more on government representation abroad.

Mr. Mullin: I think one sends a mission after one has identified that there is a target to send a mission to. Our science counsellor is trying to create the impression that there are perhaps more useful targets than they have thought of to date.

Dr. LeClair: There was a mission from Japan here two or three weeks ago looking at the Athabaska tar sands and the whole field of energy. Our science counsellor had been working on and preparing for this for many months before, and he was certainly more than instrumental in bringing that mission here.

The Chairman: What about our sending more missions abroad, that are more adequately prepared than they sometimes have been in the past?

Dr. LeClair: You are assuming we have not been sending enough and that they have not been prepared.

The Chairman: On certain occasions.

Dr. LeClair: You would have to be specific, Mr. Chairman.

Senator Carter: Do the counsellors we have in various countries have means of finding things out? Do they have contacts with universities, with work going on in the universities or in the private sector in those countries, or do they confine their observation to what the government is doing?

Dr. LeClair: I am amazed when I meet with them to find out how extensive their réseau is; they have their fingers everywhere. It is perhaps more evident in government circles; they seem to know everybody. When you travel around the country with them you find they are on almost a first-name basis with most of the important people in government, and also in industry. For example, on my last visit to the United Kingdom the science counsellor introduced me to quite a number of people in British industry concerned with R&D. He knew all about them, and, what is

perhaps more important, they knew him; they knew who he was; they had had fairly regular meetings with him. It varies with the personality of the individual, of course. They are not restricted to government circles; they are there to find out what is going on in all fields of R&D.

The Chairman: I have one final question on this section. There seems at the moment to be an expanding effort in different countries on what is called big technology, where even the United States cannot be self-sufficient. To name a few examples, there are energy, advance transportation systems, the technical development of communication satellites, and oceanography, which you have already mentioned. Could you give us a list of areas where Canada is actively engaged on an international basis with other countries in terms of programs and projects?

Dr. LeClair: Mr. Chairman, if I may, I should like to table this list of big projects with you at the next meeting. I am not sure we will be able to give you the complete list right now. This is an important subject. We have found recently that in the field of so-called big science, where a lot of money is involved, most countries now do it on a bilateral or multilateral basis. This is more evident in Europe between the members of the European Community, but also between individual members of that Community and other European States. We find that by and large in most of these places you see either the United States or Japan. Canada is not often present, and this is something we are looking at very carefully at this time. We could give you a few examples. There is the telescope between France, Hawaii and Canada; the remote manipulator in NRC with NASA. Those are fairly large programs. There may be a few others, but I think it is fair to say that this is an area where Canada is just starting to look at the possibilities of doing "big" things—"big" being defined as meaning large sums of money—with other countries.

The Chairman: We will get that list.

Dr. LeClair: You will get the list of these projects, as we know them, next time.

Senator Carter: I should like to follow up on that question about joint projects. Germany and the United States have become research partners. Do we have similar capabilities? Are we developing any arrangements like that? Do we have any natural research partners, apart from joint projects such as have been mentioned?

Dr. LeClair: It is true that there is a special kind of relationship that can be seen between Germany and the United States in R&D. However, as in everything else, we are so close to the United States that we cannot forget that in most cases we are closer to the United States than any of these countries. I do not have a quantitative analysis of what Germany does with United States. This is a personal opinion, but I would be surprised if they had as many as we have. I would be surprised if they could fill eighty pages, like this booklet, of joint projects strictly in the area of government, not, as Mr. Mullin said, including industry. We tend to forget that we have a tremendous exchange of science technology with the United States. It has been going on for so many years that we do not quantify it; we do not talk too much about it. Except perhaps in some major projects, such as we have been talking about, which you have excluded in your question, I would be surprised if there were more than we have.

The Chairman: We are just about to launch a huge research program in the field of energy. We are late in this.

In any case, apparently we are about to do it. Before we define the Canadian content of that research program, have we looked, as a country, to possible co-operation with other countries to work more or less together in the same area?

Mr. Mullin: First of all, we may disagree with much of the past. There have been energy programs for a long time. Canada, in reviewing, and perhaps changing, some of the emphasis has also been looking at its relationship with other countries, partly through the international energy agency, where there may well develop some multilateral projects in which Canada could become a partner. That is being looked at as one option. The Department of Energy, Mines and Resources have particularly been looking at other countries, West Germany being an example, as a potential partner in energy technology developments. There are other countries that are looking to Canada as a potential partner. The United States admitted some interest in heavy water reactors not too long ago. There is a reorientation of some sort going on. There is a concerted effort to look at the outside, recognizing the size of the job ahead. The Japanese mission looking at the tar sands is another example of something that might lead to collaboration in some sense.

The Chairman: Have we talked with, for instance, the Swedes, who have developed a special expertise—I do not know if it is very much advanced—in the area of long-distance transmission of electricity? This is a great problem for us.

Dr. LeClair: I think this is an area in which Canada should be proud. We are probably ahead of everybody else, including the Swedes, because of the Hydro Quebec Research Station at Varennes. In the field of high voltage transmission, there have been major contacts between Hydro Quebec and the Swedes on this particular transmission of electricity as well as underwater and so forth.

Senator Manning: This is perhaps a question of a more general nature. I am wondering about the basic philosophy that is followed by the government in making decisions as to when and where these science counsellors are going to be placed and so forth. Has any one, or any department of government, the responsibility of compiling the types of scientific knowledge that are most important for this country to obtain, that may be available through more advanced work in other nations in the world, which involves really exporting scientific and technological knowledge to Canada, because it is important to us? The other side of the coin, of course, is the one mentioned, that we do have some scientific technological knowledge to export. Is there any one department or committee or group of qualified people who compile what areas of scientific knowledge Canada should be seeking from other parts of the world, which would be important to us; what scientific knowledge we have that is most exportable—and we should be fostering the export of this technology to other parts of the world?

It would seem to me that some very firm ground rules in those areas are necessary in making some decisions on where we are going to place these science counsellors. What I am a little concerned about, and I may be completely wrong in this, but in some of the comments today we have referred to the fact that many of these things involve quite a number of government departments, and other departments get involved in them on their own. It seems to me that the danger in that is that a science counsellor may

be placed in a certain embassy for the simple reason that External Affairs, or some other department, has a particular interest that arises there that causes them to suggest this. Is it coordinated in any one central place, and geared to some very firm lists of priorities, as to what scientific knowledge we want to bring into Canada and what scientific knowledge we want to export?

Dr. LeClair: It is not done in a haphazard way. The nominees are examined by a committee of the Public Service Commission, of course, but it is both MOSST and External Affairs which are concerned. It is a responsibility of External Affairs, but we are consulted. Without using the word "veto," I doubt very much that they would appoint someone we did not approve of.

The criteria, in terms of whom we appoint, are based in part on the sort of things you were mentioning: What are the opportunities in that country? What kind of message do we want this individual to give to that country? I must say, however, that we have not compeled a list of the things that we would like these counsellors to be talking about, nor do we have a compiled list of the things we would like to know from these countries. If we knew this, we would perhaps not need the counsellors. We would send the technical people directly to find out about gasification of coal. We need the counsellors to tell us what the opportunities are, and then we follow it up.

This again brings up the question as to what kind of people we send there. We have found through experience that, not necessarily but by and large, they have to have been scientists at one time in their lives, otherwise they have difficulty of access to sources of information in those countries: they do not necessarily have to be Nobel Prize winners; they do not necessarily have to be active scientists or experts in any given field. It is generalists we are interested in and perhaps, in terms of personality, the people who have enough of a background to be able to understand but, perhaps more so—as we have seen recently described—it is the type of personality that a good newspaper reporter should have. That is the kind of people we need there, people who are able to dig and come up with facts.

Perhaps Mr. Mullin has something to say about the general philosophy of whether we have a list of things we are looking for.

Mr. Mullin: We do not have a list, Mr. Chairman, but one operating rule that Canada uses, which other countries sometimes do not, is we do not have a separate budget allocation for international exchanges in science and technology. Each department is given money for its program and is expected to use it for either doing things at home or in collaboration with other countries. So, the money available to Energy reflects the domestic priority of energy. When the domestic priority there is high, there is a greater probability we will start collaboration in energy technology with other countries because those programs have a high priority and they have money to launch programs. The areas which are of a lower priority correspondingly have less money available and are less likely to be active in trying to exchange information. Therefore, in a sense, the domestic priorities determine whether or not departments and programs have the money to do the exploratory work of sending missions over and establishing contacts and then getting into joint programs. So, the people with the high priority programs domestically tend to be the people who send the most requests to the science counsellors. It is

in that sense that our domestic priorities are reflected in what the science counsellor does on the ground and in the country.

Senator Manning: How far does that influence the decision as to where you place these science counsellors? If I may oversimplify it, take this case referred to a couple of times of gasification of coal. We could probably assume that is very important to Canada. There are probably two or three countries in the world, that we can all think of, which are pretty well advanced in that. If that is the high priority—this is in this hypothetical list I am talking about—then it would seem to me the responsible department of the Canadian government would say, "We have reached a decision that it is vital, in Canada's interest, that we gather the best available data in the world on gasification of coal, there being one, two, three nations that are quite advanced." On that ground, you then place the science counsellor or take whatever other comparable steps necessary to do that specific thing, rather than merely say, "We have eight of these counsellors scattered around the world and we will tell them we are interested in picking up anything they can on gasification of coal."

It seems to me a very general way of doing it. I am not saying that is the way you are doing it, because I do not know. I feel it would be in the national interest for us to be very specific by starting to define what we most require in the science field. Then, after determining the areas of the world where that science is most advanced, we zero in on that for that specific purpose.

It would be the same in reverse for the export of science. If we know a nation which we assume would be interested in a technology which is well advanced in Canada, that is the place we ought to be sending people specifically to sell it, not just saying to all of our counsellors, "If you have a chance to promote this Canadian technology, do so." In my view, that is a general approach rather than a specific approach.

Dr. LeClair: Taking the example that the honourable senator has mentioned, the role of the counsellor in coal gasification would not be to tell us what is happening in coal gasification. There are many other things in that country, outside of coal gasification. That man cannot be an expert on coal gasification and an expert in many other fields which are of interest to us in the United Kingdom. It is based more on the potential of that country, in terms of knowledge, that we send someone. We do not expect, nor in practice is it so, that the counsellor will tell us what they are doing in coal gasification. He will tell us that the United Kingdom is well advanced in coal gasification and then the department responsible—in this case the Department of Energy, Mines and Resources—will make sure they do send specialists in coal gasification who want to learn more about the technique. We do not expect the counsellor himself, or herself, to tell us exactly what is happening. He is to alert us, and then we take it from there—"we" meaning the interested department.

Senator Manning: Are the science counsellors in these various embassies advised of an order of priorities, of Canada's interest in particular categories of scientific knowledge? Again, using your illustration, if this counsellor you are speaking of is in a nation which is pretty well advanced in gasification of coal, would he be specifically told that one of the things we are particularly interested in, when gathering information for us, is that this information would be sufficient for our department to decide to

send somebody in the scientific field, who would actually get the information?

The Chairman: I think that is a very good question.

Dr. LeClair: That is why we are consulting.

Mr. Mullin: We are trying to decide who would be better able to answer this question. From time to time the science counsellors will get a central briefing, if you will, on what is going on in science policy, the discussions in Ottawa, but, as I have mentioned many times, they will be receiving also direct from the departments requests for information, and so they will see by the kind of statements which the different departments send to them, a picture of the priorities at the research level. Thus, at a given point in time, when Energy, Mines and Resources, as an example, may be particularly interested in coal gasification, the scientists will have a certain knowledge of what is going on in different countries because networks of communication in science are very highly developed. They will have enough knowledge to pose the first questions to get the science counsellor to go and check if such-and-such an institution or company in fact does have the program that we think it does, and would it be worthwhile to visit. So they will have knowledge of what is important, and, if I can define "important" as those things on which Ottawa departments are willing to spend money, they will get that knowledge in the communications from the department which sends them requests.

Senator Manning: That is a poor criterion.

Mr. Mullin: It is also a poor priority if you are not willing to spend money on it.

The Chairman: It seems to me that in all of this it is to be expected that individual departments should be primarily responsible for this. But following Senator Manning's question, it seems to me that there is an important role there for MOSST, to follow up and to see to it that departments are alert and do set up proper priorities. That is part of your job, to look at the overall system of priorities.

Dr. LeClair: Mr. Chairman, let us say the immediate motivation for doing this is not so that the counsellor in the particular country will be aware of it. We do this for reasons which are vastly more important than the counsellor. The counsellor is one of the beneficiaries, but the reason we are looking at priorities and the sort of thing that Canada should be doing, because there are opportunities or because there are needs, is something we are doing on a scale which vastly transcends the needs of the counsellors abroad.

The Chairman: If there are no further questions on this section, we will turn to industrial strategy and go to page 18 of the brief, dealing with "MOSST's responsibilities in relation to the universities and the provision of highly qualified manpower." Are there any questions on this section?

Senator Carter: Does the witness want to make any statement on this, or do we just take the brief as it is?

Dr. LeClair: I think I will just stick with what the brief has to say, Mr. Chairman.

The Chairman: When I read this section of the brief I went back to our report and compared notes. I believe we said more or less the same thing but with more paragraphs

than you have in your brief, but we did say it in 1972. It seems to me that there has been no real progress since then.

Dr. LeClair: Mr. Chairman, since 1972 there has been a major accomplishment. That was the completion of the highly qualified manpower study which was done under the aegis of MOSST. I assume you are aware of the details of that study so I will not discuss it here.

At this time, in conjunction with Statistics Canada and other departments, we are trying to see to what extent we can obtain from this survey, which was an extensive survey, some help in terms of trying to predict what kind of manpower this country will need in five to ten years from now in the scientific and technological fields.

The methodology for doing this is not good. Very few people can point to success. For one thing, it takes about five to ten years to find out whether your predictions were right or wrong. When they are wrong you always have unseen major circumstances to justify why you were wrong. Perhaps you know more about this than we do, Mr. Chairman, being in the economics field. We are now trying to develop a methodology. We have attracted, and are still looking for, people who have been doing this. There is a body of experience in Manpower. There are people in other countries who have tried to do this. This is exceedingly difficult, but it is extremely important because more and more we may have to justify science expenditures in a quantifiable manner. You cannot quantify the search for new knowledge; it is very difficult. You can say how many publications you have come up with, but that is not a good quantification. If, for example, we could quantify, with accuracy, the kinds of highly qualified scientific and technology manpower which this country will need five and ten years from now to meet our needs and our problems, then that would be relatively easier than trying to come up with some figures which would be dependable as to how much money, for example, you should give the councils, because one of their major functions is to train scientists and researchers.

That is the stage we are at now. We do not have any answers and we are—not “worried”, but apprehensive that the state of the art as it exists will not permit us to do just that.

Senator Godfrey: Forgetting about the future for just one moment, how are we doing right now so far as the balance between supply of and demand for research is concerned?

Dr LeClair: That is difficult to answer, but whatever we are doing is by accident. I do not think that we have ever planned in the past for the levels of money being given by the councils; I do not think there has ever been serious planning to try to meet the demands—for the various reasons I was talking about. If we had done this five to ten years ago I do not think the situation would be any better, because five years ago who could have predicted what is happening in universities right now, for example? It would have been most difficult.

Mr. Chairman, you might want to ask Mrs. Thur what she thinks about this. She is the Assistant Secretary in charge of the University Branch.

Mrs. L. M. Thur, Senior Assistant Secretary, Universities Branch, Ministry of State for Science and Technology: May I add a comment, Mr. Chairman?

Senator Godfrey: I wish you would answer the question. So far all I have found out is that whatever has happened has happened by accident. I would like to know what has happened.

Mrs. Thur: I would like to add a comment to Dr. LeClair's answer by saying the following: It was relatively easy to act in that field during the last ten years because we went through a very rapid growth period in the sixties so that numbers were increasing from one year to the next. We did not meet squarely the problem of whether there was a decrease, or whether we needed more or less. Students increased from one year to the other, so did faculties, and so, of course, did the applications for research, which meant that the research councils, operating on their traditional patterns, showed Treasury Board what the rate of increase was. Treasury Board answered to a certain degree and covered the needs. I would therefore underline the fact that during the last 10 years, perhaps from the early sixties to the early seventies, there were no problems. Now, suddenly, because of inflation and because of the decrease in the inceptions and enrolments in some departments and some programs, we should know more about manpower needs. We are now at the stage, as Dr. LeClair said, where we have just established research on these questions, and we do not have any answers to them.

Senator Godfrey: We do not know whether we are in good supply or short supply at the present moment.

Dr LeClair: We know what the situation is at the present moment for specific disciplines, but there is no general statement that will cover them all. In some of them we have too many, in some of them we have too few, and in others it is just about right; so I would think it would have to be by disciplines, not forgetting, however, that the very presence of these people creates a demand, and it is very difficult to say to what extent the man and the needs are the same.

The Chairman: That is an old economic law enunciated by Jean-Baptiste say: “Supply creates its own demand.”

Senator Carter: If I remember, Mr. Chairman, a few years ago we had some Ph.D.'s on the bread line, or applying for unemployment insurance. Are there any doing that now?

Dr LeClair: I know of none specifically, but I would guess there are. It is, however, a guess.

Senator Bell: How does the operation of the universities tie in with provincial control of the amount of money that is going to be spent? I am thinking particularly of medical scientists in western Canada, at any rate, and in British Columbia in particular, where we have not developed sufficient facilities for training medical researchers and medical practitioners, and so on. We have up to now leaned very heavily on those who have come to us trained by other countries. How can MOSST help in a situation where each province has its own jurisdiction in this field?

Dr LeClair: In the specific field that you are referring to, the federal government, as you know, has a fund called the health resources fund, which is a fund of \$500 million to be distributed on a per capita basis to the provinces over a 15-year period. This has been used to build facilities both in the field of education and in the field of research. Some provinces have used the fund extensively to build research facilities and others have used it more for educational facilities. Some provinces have not used it all very much as

yet. They have a credit to their account, if I may express myself in that way. They have not yet built any of these facilities.

To have access to this fund, which is paid for 50 per cent by the federal government and the other 50 per cent by some other body—usually the provinces—the onus, or initiative, has to come from the province in question. It is not the federal government that says to, in this particular case, the Province of British Columbia, "You will build a facility here." The federal government waits until British Columbia decides to build a facility. There is a committee made up of all the provinces that agreed to this. When recommendations have been made to the Minister of National Health and Welfare up to now, he has said yes to all requests, so if any province, relative to other provinces, does not have as many facilities in this particular field, it is by and large of their own choosing.

Senator Bell: If there is a decision that has to be made regarding the priority of upgrading, for example, medical research, does MOSST have any informal way of bringing the various provincial counterparts together to promote this?

Dr. LeClair: In specific fields, like the medical field, yes. There is a conference of deputy ministers of health, there is the committee on health resource facilities, and so forth; but in the overall, general field of science, the answer would have to be no. This statement should be nuanced, however, by the fact that at this time, during this month in particular, we will be discussing with the provinces the possibility of having some sort of mechanism which will enable us to examine this kind of problem, at least in the university field, where we may have a formal way of sitting down with the provinces and looking at the problems of university research. Up to now this has been limited to university research, but I would hope, if it works well, that we can then extend it to other fields.

Senator Rowe: May I revert to a point that Senator Carter raised a moment ago? He said that two years ago one heard of Ph.D.'s—and I take it he was referring to Ph.D.'s in science and technology of one kind or another—being on the breadline. You were talking of recent years, Senator Carter? You were not talking about the 1930's?

Senator Carter: No.

Senator Rowe: I have heard of this many times, and we have had some concurrence on the subject here today, suggesting that the situation still obtains. Is there any reality to this, or is it a myth? I confess—and I have had a lot to do with Ph.D.'s and university graduates this last 20 years—that I do not know a single one who was ever unemployed, apart from, perhaps, for a few months after graduating from university, when he might be looking around and might be temporarily indigent. Apart from that, however, I do not know one who is unemployed. Is there any substantial body of highly trained scientific personnel in Canada looking for work? Or is this a myth?

Dr. LeClair: If the question is, "How many are on unemployment insurance?" the answer may be, "Very, very few." However, if the question is, "How many are doing something for which they are overtrained, or for which they were overtrained in the past, and have not been able to get jobs to the full extent of their capabilities?" the answer is that I do not know; but I would feel that in the latter case it is perhaps not a myth. This is the sort of

information that we could probably get from the highly qualified manpower studies; but unfortunately that only gives us a picture of the situation as it existed during the month of that questionnaire, which was two or three years ago. The possibility now exists, however, that statistics Canada may, from now on, include this in their census. If they do this, we will have an ongoing picture of what is happening to these people. I do not know of a Ph.D. in this situation either, by the way. I have never met one myself, either.

Senator Rowe: May I just pursue this a little further? In the province from which I come—and I am sure this is true in other provinces...

The Chairman: And the province in question is Newfoundland.

Senator Rowe: It is Newfoundland. We encounter a great many people at the scientific level there who have come from Pakistan, say, or Sri Lanka, or India, or even Bangladesh, among others. This is true, I think, across Canada. Let me say at once that nobody is happier to see these people in Canada than I am. I have some familiarity with these countries, and I know their problems. If, however, we have sizable body of scientific personnel who are not being utilized, or who are being under-utilized, or under-employed, in Canada, how do we explain this other phenomenon, especially in view of the fact, the very patent fact, to those of us who are familiar with these countries, that they need these people themselves? When I was in Sri Lanka last winter, we heard that complaint quite frequently; we heard it in Pakistan; we heard it in other developing countries of the world also. They are suffering a drain of these people. They are coming over here to Canada and other western countries when they are needed at home. If we do have this problem of our own people being under-employed or under-utilized, or actually unemployed in fact, as we sometimes hear, then surely something is wrong, isn't it?

Dr. LeClair: Mr. Chairman, I will have to implore immunity here and ask you perhaps to direct that question to the minister when he comes next week. I think this is a question which is strictly in the area of government policy.

The Chairman: It seems to me, though, that there is also a kind of factual aspect to the question. Is this trend, of foreign qualified scientists and engineers coming to Canada, still developing? It is just a question of fact, really.

Dr. LeClair: Well, I would say that you are right in your facts. There is no doubt about that. This is true not only for scientists. For example, in the last decade the Province of Ontario had more than 50 per cent of its practising physicians come from outside the province and, in many cases, from outside the country. This is a problem which Canada has not only in the field of science but in the field of highly qualified people generally. As to whether the trend is abating—and I am sure to be asked to comment on this—my own feeling is that it has not abated yet to a significant degree, but I do think we are now quite aware of this, and I think it is a problem that we will have to address ourselves to very seriously. You know, for example, that in the medical field provinces have now started to address themselves to this by saying that anybody who comes to the province to practise medicine and who is a graduate of a foreign country will have to practise in a designated area, at least for a while. He will not be able to open up an office,

say, in downtown Toronto. To receive a licence he will have to go to some outlying area. Unless I am mistaken, British Columbia has made that same decision recently.

Senator Bell: Yes, the B.C. College of Physicians and Surgeons did it themselves.

Dr. LeClair: On an experimental basis. It is the sort of problem now being looked at. But so far as the trend is concerned, I am sure Mrs. Thur has something to add to this.

Mrs. Thur: I should like to add just one comment and that is to say that there is one area of sensitivity where we know with sure knowledge that there will be problems. As you might remember, it was the AUCC, the Association of Universities and Colleges of Canada, who asked the federal and provincial authorities—namely, those who are responsible for immigration and the ministers for education in the provinces—to make sure that within the universities if there should be a need to hire scientists Canadians should be considered first, because there was an ongoing trend to invite well qualified foreigners to enter our universities, and this sometimes meant that Canadians were not considered first. The official organization has asked both the federal and provincial authorities to reverse that policy and to oblige, to a certain extent, even universities to consider Canadian candidates first. So that is the only area where we know that there is a problem, and it has been identified.

Senator Godfrey: On this question of Ph. D's being on the breadline, I happened to be on the Canada Council four years ago when this was in the papers. I brought it up at a meeting of the Canada Council and there were several university presidents there and they denied vigorously that there was any unemployment among Ph. D's, despite what the papers were saying. I personally knew of a couple and I brought them up and it turned out that they were what they call ABDs—all but dissertations. I thought these two men were Ph. D's, and it turned out that they weren't; they still had not got their doctorates. So that was the area where there was difficulty in getting employment. If you actually had your Ph.D. there was not any difficulty. It was the people who were nearly Ph. D's who were finding it difficult to find employment.

Senator Rowe: Can we get some statistics on that?

Mrs. Thur: We have some estimated figures, but I am approaching them with necessary reserve. The figures quoted showed that there was an unemployment rate of 8 per cent of Ph.D's, and an underemployment of 20 per cent. I should like to underline the necessary reserve because what do we call underemployment? I should like to illustrate that very briefly. Our Ph.D's were accustomed, after obtaining their degree, to enter the university career to become professors, or to do research or something of that nature. That was a very easy-going solution, because we went through this very strong-growing 10 years from the sixties to the seventies. Universities were looking for Ph.D's desperately and were very happy to hire those who finished their studies. That period is now over in the universities. So if we consider someone with a Ph.D. who cannot join a faculty of a university and for that reason has become unemployed, any figure might be valid. We must therefore be very careful in interpreting these figures, which are estimated and must be interpreted in their historical context.

Senator Godfrey: I personally see no reason why Ph.D's should confine themselves to the academic sphere; they can be very valuable in other fields.

Dr. LeClair: That is a very good point, and I would hate to see tomorrow morning on the front page of any newspaper that eight per cent of Ph.D's in Ottawa are unemployed or underemployed. It is just that they may not be employed in the same kind of field as they were five years ago.

Senator Neiman: Mr. Chairman, there was in a Toronto newspaper during the last two or three weeks a fairly extensive article with respect to this subject, in relation to which various interviews were held with those who have considered this underemployment or unemployment according to their educational status. They interviewed, I believe a biologist. The point you made was that some of the Ph.D's are trying to acquire positions in universities and the positions are simply not available. Simply because they want to get in, it does not mean to say that the vacancy is there for them to fill.

Senator Carter: I would like to return to earlier questioning on the part of Senator Godfrey, with respect to working surpluses and shortages. I believe Dr. LeClair said that while he could not give an overall picture, it could be indicated by discipline. Do you have any figures by disciplines over the last five years in which there have been surpluses and shortages?

Dr. LeClair: With the usual reservations referred to by Madame Thur, but there have been figures. The engineers, I believe, recently published their figures. However, how meaningful are they? When we were looking at this, we did consult with an expert from MIT on manpower planning. He has developed a theory, and is quite adamant that he is right, that when you find that there are too many engineers, for example, coming out of engineering schools, usually this is a time when students say that they are not going into engineering, but he says that is the very time they should go into engineering, because the trend corrects itself so rapidly that there are continual ups and downs and the cycle is five to 10 years. The only reason I mention this is that we must be very careful. The fact that we may now have a surplus in a given discipline does not mean that we should advise young people not to take that discipline, because it seems to be self-corrective. No matter what we tell them, they will not take that discipline, and by the time they get out of school, five to 10 years from now, there is a great demand for them.

Senator Carter: But we should not have to wait five years; we should have a forecasting service to project what will be needed in five years' time. Do we have such a service?

Dr. LeClair: No; this is what I was saying. The methodology to forecast this to any degree of seriousness is really non-existent. For example, what is the implication of the development of the tar sands for the kind of scientific and technological people Canada will need five to 10 years from now? This in itself could be a study; it could be predictions, but would we be sure enough about these predictions that we would start programs at this time in universities, or advise young people to go into this? It seems that history has taught us that something always happens of a major nature which makes this very difficult. I am not arguing that we should not do this kind of

planning. I am arguing that we should have to do this with a lot of care.

Senator Carter: But if we take each discipline separately and go back over five years and draw a graph as to how far our needs were met, surely we could see there where the shortfalls have been, find some reason why, and relate it to the other factors? It might not be 100 per cent accurate, but surely it would be within 75 per cent accuracy of what is likely to happen?

Dr. LeClair: I think, sir, we would be dealing with how well the demand has been met, not the needs. They are quite different. We are not as interested in meeting the demand as we are in meeting the need. We might do this study, but what would be the criteria to say that these people were either employed or were in over-supply? The only criteria we have now is what they are doing. To come back to what the chairman said, they may be doing something, not because there was a need for them but because they happened to be there and they created the need.

Senator Carter: I would like to follow that a little further. When we were looking into this question five or six years ago, we found that the Science Council was giving out grants to universities and that certain grants went to a professor who had a pet project. He employed half a dozen students on this particular project. Eventually they left, but the professor perpetuated this project. As one batch went out another came in. It was self-perpetuating operation. When those fellows got out, industry found they did not have the kind of training that needed. They were under-employed because they were not trained to meet the demands of industry. So it is the needs of industry and not the needs of those who have graduated; it is the needs of industry for certain specific types of training.

Dr. LeClair: That is what I am saying.

Senator Carter: What have we done so far to remedy that situation?

Dr. LeClair: That is exactly what I was trying to say. I was talking about the needs of society, not the needs of the graduates, because that is demand.

The Chairman: I would call it supply.

Dr. LeClair: In a sense it is demand, because they are demanding a lot of R&D money. They are applying for grants, and in that sense it is a demand. I remember this argument very well. If I am not mistaken, you referred to this in your report as a specialist in camelology—camels that would perpetuate themselves?

Senator Carter: Yes.

Mrs. Thur: I should like to attempt to answer the question. We have tried to concentrate on needs or potential demands for highly trained manpower. To do that we shall take into consideration the major econometric models which are used in Canada to forecast the growth of our economy for the coming term of 15 years. I will just mention the major sources. We have a model in the Economic Council; we have another one adapted to the government's need in finance; we have one in the Bank of Canada; and we have one in the University of Toronto. We shall try to deduce from these economic projections—which include, first, the private sector's needs and, second, the government's needs, taking into consideration all the

major government projects—the potential demand for highly qualified manpower. Having done that, I should like to add that we shall never get a precise indication of how many chemical engineers we will need in 15 years, but we shall certainly have sufficiently valid information to indicate and show the warning point, really, for the whole system, for the financing, for the opening of graduate schools, and so on. It will also be valid as information given to students, who should be made aware of what the future will look like. Finally, it will allow universities and the provinces, who are directly responsible for universities, to revise and to adapt the changing patterns to university curricula. That is what we would like to achieve, and it would be a lot if we could do so.

Senator Carter: Have we reached the point where industry and the universities consult each other to find out what the needs are?

Mrs. Thur: I think there is a beginning to that, senator. In each one of the provinces, there is a council of universities, a global organization, which discusses future training programs and curricula, and to establish new curricula we have to be authorized by these councils, and the councils also ask for the advice of industry.

The Chairman: It seems to me we have covered the brain gain and also the so-called underemployment of our qualified scientists and engineers in Canada. One aspect which we have not touched upon yet is the brain drain. I have seen in the newspapers recently, for example, that first class researchers in the field of medicine and health are going to the United States because of the lack of funds provided in Canada to pursue individual projects.

Dr. LeClair: By and large, Mr. Chairman, I think these reports have, up to now, been exaggerated. I am not saying that will not happen, given the freeze on council moneys, and so forth, but by and large, at least in recent years, I think Canada has been the beneficiary rather than the loser. This may have had something to do with the fact that many Canadians who had gone to the United States wanted to return to Canada to live or to raise their children. The figures, as tentative as they may be, indicate that in some fields at least—medicine being the one I know best—the balance has been in Canada's favour.

Senator Bell: Mr. Chairman, there is another "X" in the equation, and I do not know how we are going to deal with it. It is necessary to have this information projected, but every time we have a change in government or even a change of heart in government, policy changes, we have a brain drain. We had this problem in British Columbia where some of our most highly developed technical people left because no mining was being done, no new development, no exploration. Another example of a brain drain as a result of a change in government policy occurred when the Avro Arrow was scrapped. The lunar extension module, I understand, was entirely developed by expatriate Canadians. How can you project such policy changes into analyses of what we will need in the future?

The Chairman: We cannot forecast the result of provincial elections, or even federal elections.

Senator Godfrey: Especially the 1957 one!

Senator Carter: Dealing with the brain drain, has MOSST conducted any surveys as to the number of scientific jobs in the federal government that are filled by immigrants or foreign scientists?

Dr. LeClair: I am quite sure we do not have that information, senator. I am told, Mr. Chairman, that in your recent questionnaire you asked for that information, so you would be able to tell us what the answer is when you receive your questionnaires back.

Senator Rowe: Some of these figures, I should think, Mr. Chairman, could be hugely unreliable. For example, I have a son who is a scientist. He holds three scientific degrees. He used to teach at university, but he is now a politician. In any survey, is he under-employed?

The Chairman: It depends on if he has been elected!

Senator Rowe: He has been elected.

Senator Godfrey: He is certainly not under-employed. Let us get that on the record.

Senator Rowe: I do think we need more figures, certainly than I at any rate have seen so far.

The Chairman: Let us close by saying we hope you will be able to improve the methodology and the system of gathering statistics on this vital question, because it affects so many aspects of science policy.

Unfortunately, we have to stop now. It is rather late, and anyway Dr. LeClair has to catch a plane. I was hoping that we would be able to cover other aspects of the brief today, but this will have to be postponed until a future meeting. We will meet next week, I hope at 3.30 p.m. On that occasion we will deal with industrial research in Canada and government assistance in that aspect of research. On that occasion the minister, Mr. Drury, will be with us.

The committee adjourned.

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FIRST SESSION—THIRTIETH PARLIAMENT
1974-76

THE SENATE OF CANADA
PROCEEDINGS OF THE
SPECIAL COMMITTEE OF THE SENATE ON
SCIENCE POLICY

The Honourable MAURICE LAMONTAGNE, P.C., *Chairman*

Issue No. 4

WEDNESDAY, FEBRUARY 18, 1976

Fourth Proceedings on

**The Study of Canadian Government and
other expenditures on scientific activities
and matters related thereto.**

(Witnesses and appendices: See minutes of Proceedings)

THE SPECIAL COMMITTEE OF THE
SENATE ON SCIENCE POLICY

The Honourable Maurice Lamontagne, P.C., *Chairman*

The Honourable Donald Cameron, *Deputy Chairman*

and

The Honourable Senators:

Asselin	Hastings
Bélisle	Hicks
Bell	Lang
Blois	Manning
Bonnell	Neiman
Bourget	Riel
Buckwold	Robichaud
Carter	Rowe
Giguère	Stanbury
Godfrey	Thompson
Goldenberg	van Roggen
Grosart	Yuzyk
Haig	

27 Members

(Quorum 5)

Order of Reference

Extract from the First Report of the Special Committee of the Senate on Science Policy, presented on July 10, 1975 and printed as an Appendix to the Minutes of the proceedings of the Senate of that day, and adopted by the Senate on July 24, 1975:

"The Committee, therefore, recommends that it be authorized to consider and report on Canadian government and other expenditures on scientific activities and matters related thereto;

That the Committee have power to engage the services of such counsel and clerical personnel as may be necessary for the purpose of the inquiry;

That the Committee have power to send for persons, papers and records, to sit during adjournments of the Senate and to report from time to time; and

That the Committee be authorized to print such papers and evidence from day to day as may be ordered by the Committee."

Robert Fortier,
Clerk of the Senate.

Minutes of Proceedings

Wednesday, February 18, 1976
(13)

Pursuant to adjournment and notice the Special Committee of the Senate on Science Policy met this day at 3:35 p.m., the Chairman, the Honourable Senator Lamontagne, presiding.

Present: The Honourable Senators Bourget, Carter, Giguère, Grosart, Haig, Lamontagne, Lang and Yuzyk. (8)

In attendance: Messrs. Philip J. Pocock, Director of Research, and Jacques W. Ostiguy, Chief of Administration.

The Committee resumed consideration of its Order of Reference dated July 24, 1975 relating to the study of Canadian Government and other expenditures on scientific activities and matters related thereto.

The following witnesses, from the Ministry of State for Science and Technology, were heard:

The Honourable C. M. Drury, P.C.
Minister;

Dr. M. J. LeClair,
Secretary to the Ministry;

Dr. Peter Meyboom,
Assistant Secretary,
Industry Branch;

Dr. A. R. Demirdache,
Director,
Technological Forecasting and
Technology Assessment Division.

Mr. Drury tabled a document entitled "Canada's International Collaboration in Science and Technology". The Chairman directed the Clerk of the Committee to have this document printed as an Appendix to this day's Minutes of Proceedings and Evidence. It is printed as Appendix No. "14".

During the course of his introductory remarks, the Chairman mentioned that four (4) tables of statistics had been made available to Members of the Committee. It was agreed that they be printed as an Appendix to this day's Minutes of Proceedings and Evidence. They are printed as Appendix No. "15".

During the course of the meeting, the Minister and his Officials answered questions put to them by Members of the Committee.

At 5:15 p.m. the Committee adjourned to the call of the Chairman.

ATTEST:

Patrick Savoie,
Clerk of the Committee.

The Standing Senate Committee on Science Policy

Evidence

Ottawa, Wednesday, February 18, 1976

The Special Committee of the Senate on Science Policy met this day at 3.35 p.m. to consider Canadian Government and other expenditures on scientific activities and matters relating thereto.

Senator Maurice Lamontagne (*Chairman*) in the Chair.

The Chairman: Honourable senators, I understand that Dr. LeClair or the minister wants to table some documents as a result of our discussion last week. (For text of document, see appendix "14")

The Honourable C. M. Drury, Minister of State for Science and Technology: Mr. Chairman, at the meeting last week we were asked to give some indication of our participation in international collaboration in science and technology. While this list is not exhaustive, we have used the intervening week to prepare a list of a number of projects in which we are engaged in international collaboration, and I will table this. Perhaps at some future meeting the committee will want to elaborate on it.

The Chairman: Thank you very much.

Today I hope that we will concentrate on government support to industry in the areas of science, technology and innovation. This support, as you know, includes mainly grants, programs, the "make or buy" policy and government in-house scientific activities serving an industrial mission. These matters are covered in MOSST's brief in subsection 4 of section C entitled, "MOSST's responsibilities in relation to industrial strategy," in section G entitled, "The Government's position regarding the performance of science and technology activities in federal departments and agencies," and finally in the section of appendix C dealing with "make or buy."

However, before we proceed to discuss those issues, honourable senators will perhaps remember that I raised one specific matter towards the end of our meeting on December 16 which remains pending, and remained pending at that time in the absence of the minister. It has to do with the advisability for MOSST to issue an annual publication shortly after the main estimates—this is a good day to ask this question—have been tabled in the house, showing in some detail the science budget display for the coming fiscal year, together with the main orientation of priorities of science policy.

Before asking the minister to react to this proposal, I should like to preface my question by making the following observations. First, the minister, in paragraph 5 of his brief, expressed "strong support for any new mechanisms by which Parliament can be increasingly informed and concerned regarding science and its impact on Canadians."

Secondly, it is quite evident that the single page devoted to proposed science expenditure in the publication entitled "How your tax dollar is spent" cannot meet that objective.

Thirdly, a growing number of governments in other countries are providing the kind of information that we are seeking here as parliamentarians. In France, for instance, the government issues an annual document, which is an annex to the financial bill for the coming fiscal year, and which explains in some detail the purpose and nature of proposed scientific expenditures. This document is probably the best of its kind, and with appropriate adjustments could well be used here in Canada as a model.

Fourthly, the annual publication entitled "Federal Scientific Resources", issued by MOSST, is, at least in my view, a mere statistical recapitulation of past and current expenditures, containing no information, not even general information, on specific programs. It appears later, and is much less informative, I think, than the series of documents on scientific activities issued by Statistics Canada. To that extent it can be seen as a useless duplication.

Finally, during our December 16 meeting Dr. LeClair told us that the ministry is now already able to prepare an annual publication along the lines of the document issued annually by the French government. He added, however, that the decision as to whether or not a similar Canadian document should be prepared and published was of a political nature and therefore had to be taken not by officials but by the minister.

With this long preamble, I am now asking you, Mr. Minister, if you are prepared to authorize the publication of a document of this nature as a new mechanism "by which Parliament can be increasingly informed and concerned regarding science and its impact on Canadians".

Hon. Mr. Drury: Mr. Chairman, without accepting all the pejorative adjectives you have used in relation to our current publication, we have been looking at and trying out a pro forma document of an anticipatory and expository character, which would be rather more complete than what is contained in "How your tax dollar is spent". I have not yet got the agreement of my colleagues that this would be a useful additional expenditure. It would cost money to publish this.

The Chairman: We would not see this really as an additional expense. We would see this new publication as a substitute for the existing publication, which we maintain is a kind of duplication of what Statistics Canada is already doing. It would not cost more, but it would be much more helpful for parliamentarians.

Hon. Mr. Drury: If it would not cost any more than our current publication, I think we will probably do it.

The Chairman: We will wait, then, until next year to see if inflation or austerity has prevented you from doing this.

We think it would be most useful for parliamentarians of both houses. I see a representative of the other place with us today, and I am sure he would also be interested in having such a publication.

I understand that the main estimates have been tabled today in the other place, and the minister and his officials told us previously that the new budgetary procedure involving MOSST led to an overall science budget display showing proposed government expenditure on scientific activities. I wonder if the minister can tell us what is the total amount provided in the main estimates for those expenditures, and whether that amount represents an increase or a decline in 1976-77 compared with 1975-76.

Hon. Mr. Drury: Mr. Chairman, I have a table which would answer the questions you have asked, although there are no percentage figures and the arithmetical differences have not been calculated. The information one will get today will be tabled in the house—the forecast of expenditures for 1975-76 and the estimates for 1976-77. The document tabled today will show that within the federal government establishments in 1971-72 \$589 million was spent. The forecast for the current year is \$919 million, and the estimate for next year is \$1,076 million, an increase of roughly \$150 million. Within Canadian industry, 1971-72, the figure is \$161 million; for the current year \$190 million; and increasing in the estimates to \$221 million. Within universities, \$156 million in 1971-72; \$189 million in the current year; and \$206 million next year. Other institutions, \$32 million in 1971-72; \$114 million for the current year; and \$110 million next year. This is for a total of \$938 million in 1971-72, \$1,412 million forecast for the current year, and \$1,613 million total provided for next year. So that is an increase of roughly \$200 million above this year's forecast provided for in next year's estimates.

The Chairman: So that the big increase, I understand, is again going for intramural activities.

Hon. Mr. Drury: The largest increase is for within-federal-government establishments; that is correct.

The Chairman: I see here, for instance, that you give us for 1975-76 the total expenditures for that year, but if you compare the main estimates of 1975-76 with the main estimates of this year, there is an increase of only \$10 million for industry, a decrease of \$2 million for universities and an increase of \$2 million for others, but an increase of \$176 million for intramural activities.

Hon. Mr. Drury: Yes. I am not sure that in an endeavour to compare last year's estimates, which was the plan...

The Chairman: This is the old discussion, as you know.

Hon. Mr. Drury: That is right. At the beginning of the fiscal year it was varied during the course of the year with, amongst other things, X budgets which disappeared and then were partially restored, and I think a much more valid figure is what is the fact as distinct from the plan. We should adjust our plan, which is next year's estimates, in relation to what did happen, not what might have happened. So I would think the forecast of expenditures in the current year is the valid basis from which to look forward to the next.

The Chairman: We now come to one of the most important areas of our inquiry, namely, the national effort devoted by industry to science technology and innovation, and government policies designed to sustain it. The level

and structure of that effort are crucial because, according to our information, all empirical studies show that there is a very high degree of correlation between R&D performed by industry, and economic growth, the volume of sales and profits. So that the existing literature shows, and most experts think, that industrial R&D constitutes one of the most profitable forms of investment.

It is in this perspective that we should examine the Canadian situation. I do not believe, however, that this afternoon we should devote too much time to defining that situation and to discussing figures. Whatever the figures or the international comparisons we use—and I think we have already gone over this before, Mr. Minister—it is rather obvious that this situation is quite bad and has not been improving very much recently. On the contrary.

In 1963 industry performed, according to our own information, according to Statistics Canada, about 41.3 per cent of total R&D in Canada. Ten years later, in 1973, which is the last year for which figures are available, the percentage was 36 per cent. In the same year the corresponding average figure for other industrialized countries was 63 per cent. In 1963 Canadian industries financed 33.7 per cent of total R&D. That share was only 28.3 per cent in 1973. These few figures sum up the situation pretty well and reveal conditions which should be a source of serious concern for all Canadians.

While foreign ownership and ready access to U.S. technology account to a certain extent for this situation, other factors, in my view, are also certainly present as well, and the minister may wish in a moment to mention some of them. Moreover, I am sure he will admit that too great a reliance on U.S. technology does not have only desirable results, especially in the long term. Thus, Mr. Minister, when you were Minister of Industry in 1967 you were completely justified in stating on behalf of the Canadian government:

Our first obligation, therefore, is to ensure that technical innovation activity in our industry is brought to a competitive level in the shortest possible time.

Unfortunately, this major policy objective has not been achieved. Even the government has not been able to transfer to industry a greater share of the funds it devotes to scientific activities and to R&D.

I have prepared four tables, which I have made available to members of the committee. These tables illustrate this situation, and I propose that they be printed as an appendix to today's proceedings.

(For text of tables, see Appendix "15")

The Chairman: The first two tables show that the share of total federal expenditures on scientific activities and R&D allocated to industry reached a peak in 1970-71 and has declined since. In relative terms the big gain has been made by foreign performers, although their share in absolute amount is still relatively minor. The other two tables show current federal expenditures in Research and Development contracts and grants. Here again we see that the evolution is slow and is not in favour of industry. I hope that this background information will be useful for our discussion, and that we may use these figures, which are as good as any, to portray the recent evolution. So, unless the minister wants to comment on what I have said, I would now ask members of the committee if they have questions to ask.

Hon. Mr. Drury: I am not quite sure that I see the difference between table I and table 2.

The Chairman: Table 1 is related to total scientific activities while table 2 is related to research and development.

Hon. Mr. Drury: I presume the arithmetic is correct.

The Chairman: We are not in the habit of playing with figures here. I hope there are no mistakes, but they were taken from the figures issued by Statistics Canada.

Hon. Mr. Drury: Well, I really cannot challenge the conclusions you have drawn from these figures. Both in respect of total scientific activities and research and development, there has been a heavy preponderance of this performed within the government, and moving it out, as the figures show—68 per cent as against 63 per cent—is a trend in the right direction, but it is rather a modest trend. If the objective should be to achieve national self-sufficiency or self-reliance in this respect, then we still have a long way to go.

The Chairman: Starting from there and looking towards the future, I wonder if you could explain to us in greater detail the statement made by the President of the Treasury Board on December 18 insofar as it refers to government research and development incentives grants to industry.

Hon. Mr. Drury: Well, I think what the President of the Treasury Board had in mind, in detailing the various categories of expenditure limitations made by the government, was to demonstrate that these cuts were going across the board and affecting everybody. It is to be hoped that everybody is affected in an equitable way, and that virtually no sector of the economy would be free from restraint.

The Chairman: But could you be a little more specific in terms of government programs which are of direct interest to us at the moment? His statement was a little vague. I understand most incentive programs are to be frozen and that one of them, I think, was IRDIA which was to be dropped.

Hon. Mr. Drury: The IRDIA Act, which, as reported over some period of time now by the industrial sector, has not been a useful or successful incentive was to be dropped, and this was part of an overall review of the total of our programs covering incentives for research and development. As you yourself pointed out, these have not been spectacularly successful, and it was with a view to making them more successful, more functionally efficient, that the current review is underway.

The Chairman: But what about the other programs? The impression I got from reading the statement was that no more money would be spent in the future than was spent in the last fiscal year as a result of the overall austerity program.

Hon. Mr. Drury: That is correct.

The Chairman: And that means, so far as the austerity program is concerned and so far as it affects the research in industry, that we cannot, from that point of view at least, expect any improvement from the present situation, which we all deplore.

Hon. Mr. Drury: Quantitatively one could not expect that there would be any more research arising out of, or as a consequence of, these incentives than has been the case

in the past. There is in Canada a relatively small allocation of resources corporate to this purpose. The sole source of resources for research and development within industry should not be government, whether federal, provincial or municipal. The proportion allocated by industry itself is relatively small in Canada. The incentives that we have had in the past to increase this have not been as effective as they should have been. Costs were being reviewed. I think you probably would agree that if the incentives have not been producing the desired results, it is not a very intelligent answer merely to increase the amount of money put at their disposal.

The Chairman: We recommended a review in 1972.

Hon. Mr. Drury: Well, at least the review is under way now, but it has not been completed.

The Chairman: In addition to the removal or reduction of government incentives as announced in the austerity program, do you not think that the program of price and income control will create disincentives to industrial research? For instance, as I understand them, the regulations under this program provide that disproportionate increases in the expenses for research, which are treated under this heading and for this purpose on the same basis as landscaping, decorating and charitable donations, are not recognized by the program as allowable costs. Therefore, they cannot serve as a basis to increase prices and must be deducted from profits. So we have one disincentive there. Moreover, if industrial research and development, according to the same program, leads to a reduction in cost per unit of output, that reduction will have to be entirely reflected in a reduction in price, otherwise it will generate excess profits and therefore will have to be paid to the government. I see we have a new system of sharing, and industry will have to take the risk and government will take the profits. I maintain that this is another disincentive which is added to the first one I have just mentioned under the program of price and income controls. In the light of this, I would like to know if MOSST was involved in the preparation of the anti-inflation program and if these disincentives to industrial R&D were pointed out and explicitly recognized before the program was approved by the government.

Hon. Mr. Drury: I think probably you are being rather harsh in your conclusions, the R&D being asked to take all the risks and the benefits passed on.

The Chairman: Well, you agree that if R&D leads to a reduction in costs per unit...

Hon. Mr. Drury: If R&D leads to a significant improvement in productivity, that is retainable by the company and does not have to be passed on...

The Chairman: An "irregular."

Hon. Mr. Drury: A "significant." If it is insignificant, marginal, it then has to be passed on.

The Chairman: I think, Mr. Minister, the expression is "unusual" rather than "significant." There is a difference between the two.

Hon. Mr. Drury: I guess there is.

The Chairman: "Unusual" means temporary.

Hon. Mr. Drury: I do not think it means temporary, no; it means it is not usual.

Senator Grosart: It does not often happen . . .

Hon. Mr. Drury: —with great frequency or on a recurring pattern. There is this modification, that "unusual" improvements in productivity are not subject to the kind of disincentive that you mention. Secondly, increases in cost of research and development are not direct costs; they are in the nature of overheads, and increases in overhead costs generally, in proportion to the total volume of business, are allowable increases in costs.

The Chairman: Provided they remain more or less normal.

Hon. Mr. Drury: That is correct.

The Chairman: Since we are at a very low level, it means that increasing this low level will not be acceptable as an allowable cost. That is what I mean.

Hon. Mr. Drury: Well, if there are—I might use the same term—unusually large increases, they would not be allowed as an increase in cost.

The Chairman: In any case, we agree, I think, that the austerity program will not help industrial research in Canada. Let us agree also that at least the control program will not increase or encourage further increases in industrial research. So that since the present situation is not very nice or very good, or is far from being adequate, we cannot expect a very great improvement in the near future.

Hon. Mr. Drury: I think probably the objective of increasing Canadian capacity to conduct, or to be self sufficient in respect of, research and development is what I would call a long-range objective. It cannot be argued as being needed in the short term. It does not produce rapid results, so it is a long-term objective. There is no question about it, the whole of the anti-inflation program is a short range attempt to deal in as equitable a way as possible with a short term situation.

It partakes of arbitrary and, in some instances, unnatural restraints, in some cases going so far as freezing, in the hope that during this period new changes of direction, new changes of attitude, will take place and we will be able to move into a subsequent period with rather differing practices, differing outlooks, in the hope that this kind of inflation will not recur.

It is with this in mind that we are looking at these various incentive programs designed to get—in a way in which I do not pretend that we have been successful to date—a greater capacity within Canadian manufacturing, and the service industry, incidentally, engaging in research and development.

The Chairman: In your review of these incentive programs, are you also taking into account the possibility of again providing tax incentives for research? This is one proposal that we receive from a lot of Canadian firms. They seem to prefer these tax incentives to direct grants. I wonder if this is one of the possibilities being envisaged during the current review.

Hon. Mr. Drury: Hopefully they are looking at all possible tax incentives as well as direct grants. The tax incentive scheme we had earlier has not been a marked success, and that is the reason for its being repealed. Perhaps there are other forms of tax incentives, and if this committee has any ideas, we would be glad to hear them.

Senator Bourget: What about the fast write-off? Many companies have recommended to our committee the fast write-off, the two- or three-year fast write-off, and also 150 per cent allowance for R&D. Those companies, from the letters I have read, have stressed that point. They say it would be more advantageous to their company to add, for example, the 150 per cent allowance cost and also the fast write-off. Those are the two main recommendations I have read in many of the letters I have received.

Senator Grosart: We had it once.

Senator Bourget: Yes, we had it once, and they are coming back to it. I was wondering if the minister considers that to be one way of giving incentives to those companies.

Hon. Mr. Drury: I will not try to answer that. There is not much use in having a high powered committee looking at this and my telling them what the answers are. Certainly, those are two that should be looked at, I agree with you.

Senator Grosart: Have they been looked at? Has any assessment been made as to the possible result that might eventuate from a return to that policy—the tax incentive and write-off—which seemed to be working very well until about five or six years ago when suddenly, without notice, the government changed its policy and went to this whole group of so-called incentives, none of which has worked?

Hon. Mr. Drury: You say, "none of which has worked."

Senator Grosart: None of which has had spectacular results—let us put it that way.

Hon. Mr. Drury: I would suggest that the grants which have led to the development and production of the PT.6 engines in United Aircraft have been rather spectacular as producing a development of Canadian industry in a high technology field, which seems to be highly desirable. The difficulty with that is that we have not had enough of them.

Senator Grosart: That is right. We would expect more than one in six years.

Hon. Mr. Drury: The offer was there. If it worked for one, why did it not work for others?

Senator Grosart: We hope to find that out.

Senator Lang: Under what program did the aircraft engine grant come—was it tax incentive, a grant?

Hon. Mr. Drury: DIP, defence.

Senator Grosart: The whole defence support R&D program has been discontinued.

Hon. Mr. Drury: No, not DIP.

Senator Grosart: But the defence support program has.

Hon. Mr. Drury: The Defence Research Board.

Senator Grosart: DRB. You are very close to it.

Hon. Mr. Drury: That was one of those high priced government establishments that did all of their work in-house.

Senator Grosart: They didn't actually.

Hon. Mr. Drury: Look what happens when you get rid of them.

Senator Grosart: It is one thing to get rid of them; it is another to transfer money into industry, which is what we have been talking about.

We are not suggesting you wash out all support of R&D. What we are suggesting is that there seems to be certainly an area of government policy which the bureaucracy has resisted. That is all I can gather from the figures. I went back over them after our last discussion, and the industry presentations we have had all seem to say the same thing, that the bureaucracy says, "No, we don't care whether it is government policy to make a substantial transfer of funding into industry. We are not going to do it." We had this discussion before. All the evidence is that the bureaucracy has just said "no" to government policy. You declare it, others have declared it, and they have done nothing, and nobody cares. That is my problem. Why is the government not concerned to insist that its own policy, clearly stated over and over again over the last five or six years, be implemented by the departments? That is my major question. I do not know the answer.

The Chairman: I think, Mr. Minister . . .

Senator Grosart: Let the minister answer.

The Chairman: I have a supplementary question which I think will make it a little more specific, Senator Grosart. Take the "make or buy" program. This policy has been proclaimed by the government, and the individual departments and agencies are there to enforce the program. In my view, they are put in a direct conflict of interest, because naturally they would prefer to make rather than to buy. Since there is no impartial review, that I know of, at the centre, we have the situation that you have, to give the figure you quote in your brief, that over a period of three years the "make or buy" policy has produced contracts for about \$70 million.

Hon. Mr. Drury: I have a figure here. You, Mr. Chairman, gave out a table of percentages. This is not a published table. Dealing with the period 1970-71 to 1975-76, in respect of mission-oriented research and development, in 1970-71 the percentage of mission-oriented research conducted . . .

The Chairman: I think we have already discussed that.

Senator Grosart: Yes.

Hon. Mr. Drury: —within the government was 93 per cent; it is currently 83 per cent. Within industry it was 4.4 per cent; it is now 10.9 per cent.

The Chairman: I am taking the figures included in your brief, where you say that to date contracts within industry for R&D and feasibility studies under the "make or buy" policy have totalled \$72 million. This policy, as you say, has been implemented since early 1973, so over a period of three years \$72 million has been contracted out under that policy.

Hon. Mr. Drury: Yes, I will accept that. To me, it is quite a few million dollars.

The Chairman: For me too, although I am much poorer than you are! However, if you compare this with the total effort of the federal government, I would say that it is only marginal. Before you comment on this, I should like to know how the "make or buy" policy is applied in practice. You say the departments and agencies have the onus of showing, according to certain criteria, why they should

make rather than buy. To whom do they have to show that?

Senator Grosart: Mr. Chairman, could I suggest that we get an answer to the first question, to start with, with respect to this long term policy, which the government does not seem to have insisted on? The "make or buy" policy is fairly current. The point I raised was in respect of the announced government policy and its non-implementation by the departments. Could we have an answer on whether the government intends to withdraw that statement of policy or to implement it?

Hon. Mr. Drury: Which statement of policy?

Senator Grosart: The statement you made, which I quoted to you at our first hearing. You have said that it is the stated policy of the government to transfer a substantial part of the funding of R&D in-house into industry. It has not done it. We have gone over the figures. I do not want to go over them again. It just has not happened.

Hon. Mr. Drury: I would not accept that as a statement. What we have said as a government is that the proportion of research and development carried out within industry in Canada is very much lower than it should be. To try to correct this, to raise this, the federal government will devise, as it has, a number of incentive programs designed to increase this. A number of these have been put in place, run, modified and are now being reviewed again. Secondly, we will impose on government departments in respect of all new research and development needs a requirement that they prefer this work to be done outside, within manufacturing industry, rather than in-house in government laboratories. New work means new projects, particularly those that involve the acquisition of new staff or new capital facilities. It is incumbent on government departments to arrange to have this done outside, provided it can be done outside at reasonable cost.

Senator Grosart: Does this not include a requirement that there be an examination of present policies? Mr. Minister, are you saying this applies exclusively to new expenditures, that they can go on in the way they have been doing in respect of anything that is an on-going program?

Hon. Mr. Drury: So far, it has applies to new programs, new projects. Currently we are reviewing ongoing programs, not only in respect of research and development but also in other fields, to try to arrive at a determination as to what is continuing useful and what is not.

Senator Grosart: And as to what should be contracted out—is that part of the review?

Hon. Mr. Drury: What should be contracted out? Do I understand that you feel that we should close down government laboratories and discharge government employees in research fields to get the work into industry?

Senator Grosart: Yes, if the evidence, which would be a matter of government policy, is that it can be more effectively done that way.

Hon. Mr. Drury: When you say "more effectively done," what is the test of effectiveness here?

Senator Grosart: I would start with public benefit; I would then go to its effect on our innovative capacity in industry; then I would go to our exports, and so on. The criteria of effectiveness in research have been laid down for years. There is nothing new in that. There is no great

difficulty in discovering the criteria of effectiveness in R&D. The criteria are there. Surely that is the essence of government policy, to decide whether the expenditure to public funds in R&D in in-house is more effective in terms of public policy than it is in industry. Surely, that is the whole business of government?

Hon. Mr. Drury: Well, it is not the whole business, but it is part of the business of government.

Senator Grosart: In the spending area, I assume that that is the approach the government takes to the spending of every single dollar: "How can it be spent most effectively?"

Hon. Mr. Drury: Hopefully, this is what we are about. I agree with that. There is certainly no question about the fact that we have started up, particularly in the federal government, research laboratories in the absence of any institutions in the private sector, and in a number of cases those have become the only such institutions. They do not exist in the private sector.

There are several areas in which, demonstrably, it is more efficient, certainly, to have it operated by the public rather than privately.

Senator Grosart: I agree.

Hon. Mr. Drury: Some of our larger establishments, some of our larger single projects, fall into this class. It means, then, that unless you are going to make radical changes suddenly—and any form of radicalism—tends to be inefficient the changes are going to be rather gradual and, to some degree, at the margin.

I would cite, as an example, the large facility which is fairly expensive to operate, the wind tunnel, usable by all the airframe manufacturing companies in Canada. They cannot afford one each. One has difficulty in deciding who will have it, therefore, if it is to be in private industry provided by public funds. It was the view of the airframe industry that we should have a federally financed and federally operated facility usable by them on a cost-recovery basis. This shows in the budget as significant expenditures by the federal government. The offsetting revenue coming from private industry for the accomplishment of their purposes does not show. But this is the way, not only in the government's view but in industry's view, that it should be organized. I do not think you would suggest that that kind of thing should be, willy-nilly, pushed out into the private sector just for the sake of saying that it is in the private sector.

Senator Grosart: No, no, that is not what I am saying. What I was really asking was if there is a review of these projects to see which could be more effectively contracted out. Has this been done over the whole spectrum of the billion dollars of government expenditure in this area? That is all I am asking. Is anyone going through the whole list and saying, "Could this be done more effectively in industry?", in view of the government's stated policy of five or six years ago that in overall terms there seems to be evidence that it would be more effective? Not only does there seem to be evidence, but the government says, "It is to be done."

Hon. Mr. Drury: We have a system, generally, of the provision of programs in the estimates and the securing of parliamentary authorization. Once parliamentary authorization has been secured, there is a further detailed internal

authorization called for before projects are undertaken. This is provided following scrutiny by the Treasury Board. In respect of research and development, projects, proposals, submissions, Treasury Board, seeks the advice of MOSST. Whenever any proposal for expenditure in relation to a scientific project comes up, there is then the application of the "make or buy" criterion. That covers all expenditures, but there is not someone sitting down looking through every piece of research or development engaged in by all government departments to say, "Can you contract this out?"

Senator Carter: Has any search been done to make sure the work a department is doing has not already been done by universities or in industry somewhere? In other words, to make sure that you are not duplicating what has already been started somewhere else? Have you some sort of mechanism to check that this does not happen? In other words, if you have no inventory, how do you know that what you are embarking on has not already been done somewhere else?

Hon. Mr. Drury: Obviously, the people in Ottawa sitting where I do must rely on the intelligence and integrity of the researchers. For example, there is a group of people working in a laboratory in Saskatoon to see what they can do about mutating certain plants in order to enable their roots more efficiently to fix nitrogen in the earth. I barely understand what they are saying far less know what is going on. They are working in concert with the people who are also engaged in this kind of work in this particular field not only in Canadian universities but elsewhere outside the country. To have some kind of monitor whose job it is to see that these researchers are not duplicating what someone else is doing somewhere else in the world would be a rather difficult and also a most expensive form of second guessing.

The Chairman: I would like to come back to my question of a moment ago and to restrict it only to new programs. What is the procedure which is being applied now to see that the individual departments can contract out as much as possible when it is desirable? Are they deciding this thing themselves? Is MOSST involved in this decision before it is taken, or who else?

Hon. Mr. Drury: MOSST will be involved on an advisory basis, it is to be hoped, at the outset. In any event, they will be involved when the proposal to initiate a new program comes before Treasury Board, whether the department wishes it or not, or even whether the department has thought of it or not. The experience has been that if MOSST has not been consulted or is unaware of the parameters of the situation or the satisfaction of the "make or buy" criteria, then when it comes to Treasury Board there is a delay as a consequence of MOSST having to consider it then, and the departments are learning that if they want to eliminate this kind of delay it is best to consult MOSST in advance.

The Chairman: So that there is an impartial review by MOSST for new projects before a decision is taken to make or buy?

Hon. Mr. Drury: Before a decision is taken to initiate a new project.

The Chairman: That is to start with, and then deciding afterwards whether to make or buy. Since when has this procedure been implemented?

Dr. Peter Meyboom, Assistant Secretary, Industry Branch, Ministry of State for Science and Technology: It goes hand in hand with the establishment of program review.

Hon. Mr. Drury: It is three years since the inception of the "make or buy" policy.

The Chairman: On the face of it—and I may be wrong in my interpretation of it—this review has not been very successful because, according to these figures, there will be only \$150 million more for in-house research in 1976-77 and only \$31 million more for industry.

Hon. Mr. Drury: Perhaps this is a measure of the time it takes to establish a new capacity within manufacturing industry. There have been some significant ones. The proposal for the future development of the earth resources satellite and the development of new sensors which, having started out entirely as a government operation, is now being moved out to the private sector, the manufacturing sector, to run virtually entirely on a "buy" rather than a "make" proposition. But this involves a build up of a capacity in the private sector hitherto non-existent, and this, if it is going to be done economically, cannot be done overnight, so the process of transfer is gradual.

Senator Carter: This extra \$150 million in the new estimates for this year, is any of that money for new facilities, expansion of laboratories or new laboratories or things like that?

Hon. Mr. Drury: In-house?

Senator Carter: Yes.

Hon. Mr. Drury: I don't think so. The last big expenditure we had of this kind was for the construction of the National Science Library which, after considerable examination and cogitation, it was decided to establish in-house rather than in the private sector. Now the Department of National Health and Welfare is putting up a number of testing laboratories across the country as part of its given responsibilities for food and drug testing, and this is the kind of operation which it is felt really should be provided in a government laboratory by government personnel rather than farming it out to the manufacturers who might perhaps have a special interest in the success of these things, and might not be as objective in the long haul in their testing and in their research as safety would call for.

The Chairman: You mention in your brief a number of other areas of problems relating to industrial research and development to which MOSST is giving high priority—just to mention a few, the consolidation of industrial R&D programs which you have already mentioned, the need to provide better capital and incentive rewards for inventors, the creation of a "marriage bureau" to expedite partnerships between Canadian firms and complementary companies in other countries, training programs for R&D managers. I remember we made a specific recommendation about all these areas in our second volume back in 1972. I am glad to see that those proposals have all been accepted by the government, at least in principle, instead of being forgotten. But, as I said, we made them in 1972 and we are now in 1976. When can we expect some follow-up or implementation of these proposals?

Senator Grosart: To accept them in principle is often a good way to forget them!

Hon. Mr. Drury: Well, if you are asking for precise dates, I cannot give them to you nor can I announce the arrival of Utopia in two years. We are working towards this. As these percentage figures I have quoted to you indicate a trend or movement in the right direction, we will continue to work at these things in which we believe, bearing in mind that there is a long history of past practice that has to be reversed or overcome to set sail on the new road. I must say, I commend the impatience of the committee—I experience this myself periodically—and can only say that we both have the same objectives, and I think MOSST shares the regret of the committee that these things are not as easy to accomplish, nor are being accomplished as quickly as one would hope. When you said earlier, Mr. Chairman, that the anti-inflation program operated as a disincentive to this kind of change, this kind of progress, that is quite true; there is no question about it. We, as Canadians, have perhaps been trying to do too much too quickly in too many fields. Hopefully we will now continue to make progress, albeit for the moment rather more slowly but still in the right direction.

The Chairman: I was hoping, though, that the anti-inflation program was a stop-gap which would help us meet our long-term plans and objectives. I now see that insofar as research is concerned, the short-term program will almost contradict the long-term objective in terms of research, and so on.

Hon. Mr. Drury: One could make the same statement in respect of social progress, improvement in education and health—in fact, everything.

Senator Grosart: Mr. Minister, you mention this as a concern of the committee, which it is. I am sure you know that it is also a concern of industry. Rightly or wrongly they seem to be telling us—we have the evidence here, in their replies to our letters—that they feel almost unanimously that the hold-up lies in clear government decisions. Perhaps I could quickly put one or two on the record. For example, here is a letter from MacMillan Bloedel, in which they say:

From our own standpoint, we are reasonably satisfied that a large part of the structure required in government is sufficiently in place to provide the means for ensuring continued Canadian development in fields in which science and technology are critical tools. Nevertheless, we have some doubts about the extent to which governmental policy with respect to industrial objectives and strategy has been articulated sufficiently to ensure that government agencies, despite the adequacy of organization structure, will have a proper sense of direction as they seek to discharge their programme responsibilities.

We have a letter from Syncrude which says:

... there seems to be little Canadian effort dedicated to developing these technologies ...

They are referring to the technology field:

... and this may well place us once again in the position of importing foreign technology ...

From Aviation Electric Ltd.:

The Government staff is growing when budgets permit, and industry is often not aware of new projects until the investigating Government agency has expended much time and money on study and facilities. It is acknowledged that some of the activi-

ties in Government departments do not provide sufficient market potential for commercial viability. It is questionable whether many of these activities are justified in even Government departments.

And so on. There seems to be so much evidence that we need at this time an articulate, firm, tough government decision to do something about the low level of the funding of research and development, and therefore innovation, in industry. In the OECD comparisons, we are at the bottom of the list. We are thrown in there with Iceland, Greece...

The Chairman: And Ireland also.

Senator Grosart: Yes. That is the category we are in. We all know there are long-term developments in our economic make-up that are partly responsible, but it does concern us that nothing seems to be done about it.

The Chairman: I will allow the minister to answer that question. Perhaps the honourable senator does not appreciate that the minister has to leave.

Hon. Mr. Drury: You may recollect, senator, that a couple of years ago there was a significant reduction in the corporate tax rate to allow Canadian corporations to compete rather more effectively with their counterparts south of the border, as a consequence of tax changes, particularly the DISC program, introduced down there. The hope was that with this particular tax incentive there would be available more money for development and research within Canadian corporations remaining in corporate hands.

The tax review committee which looked at the consequences of this tax reduction—how the funds remaining in the hands of the corporations were used—was—I will not say disappointed, but I was certainly disappointed, to discover that virtually none of the increased revenues remaining in their hands were put into the research field. These figures that the Chairman has quoted demonstrate this. Despite a significant incentive tax reduction, Canadian industry chose not to employ, to allocate, these additional resources in any significant way to research and development. You can hardly blame the government for this.

Senator Grosart: That could apply to the devaluation of the dollar, to a change in monetary policy, and everything else. The industry would immediately say they needed it to stay alive, and some of them didn't. To say that this is an indication of their unwillingness to spend money on research and development is, I think, a complete *non sequitur*. They had other reasons.

The Chairman: Senator Grosart, I think we shall need another meeting with the minister, if he has time, because we are dealing mostly with policy issues at this stage. I still have a number of questions to ask in this area. I would like also to hear much more about the new role which is being assigned to NRC, according to the minister's brief. So it seems to me that we will need another meeting. I wonder, Mr. Minister, whether you will be available next week?

Hon. Mr. Drury: I shall be glad to attend. Next Wednesday afternoon?

The Chairman: That seems to be the most convenient time for you.

Hon. Mr. Drury: I think so.

The Chairman: If the Committee is agreeable, we shall continue. I have a couple of questions still to ask.

Hon. Mr. Drury: Thank you, Mr. Chairman.

Senator Carter: Mr. Chairman, I know the minister was in a hurry. I did not want to hold him up; but I did not quite understand his answer to your question about the decision-making process. I gather he said that MOSST came into the picture and was consulted right at the beginning; but then someone had to make a decision as to whether this should be done in-house or outside. If he gave the process by which the decision was made, I did not get it.

The Chairman: I would presume that Treasury Board takes more or less the final decision on this, on the advice of MOSST, and, of course, taking into consideration the views of the department concerned.

Dr. M. J. LeClair, secretary of the ministry of state for Science and Technology: That is true. We try to be involved at the very beginning, because we find from practice that this is the time to have some influence. We are talking now only about new projects and new money in "make or buy".

Senator Carter: I understood from what the minister said that MOSST came into the picture only to decide whether the new project would go ahead.

Dr. LeClair: No. We are involved not only in whether the new project will be done, but in whether the project will be done in-house or contracted out. Our final recommendation to the Treasury Board bears on this matter as well. For instance, if it is a major project, where a decision of cabinet is needed, that is also incorporated in the decision of cabinet and it has to be contracted out. To give an example, nearly all new funds for S & T since 1974-75 have been contracted out.

Senator Grosart: To industry?

Dr. LeClair: Yes.

Senator Grosart: What about the universities?

Dr. LeClair: The universities to some extent. However, let us not forget, as I think I mentioned before, "make or buy" was for industries, not universities. Most of the intramural increase is from salaries, not from new projects. I think we can say that for new money, new projects, since 1974-75 nearly all have been contracted out.

Senator Lang: Can you break down the percentage of moneys that are contracted out, as between contracted out to domestic Canadian companies and contracted out to Canadian subsidiaries of foreign companies?

Dr. LeClair: The minister was referring to an internal review of the incentive program. This includes "make or buy." That review has just been finished but has not yet been fully discussed or presented to the ministries. We have this information, but I cannot give it to you. Perhaps the minister will want to give it to you next time. This information is in this folder. It has been done; it has been looked at in the way you mention.

Senator Lang: Is there a tendency on the part of departments or on the part of MOSST to avoid a gamble on a proven Canadian R&D resource as opposed to a proven foreign R&D resource?

Dr. LeClair: Whether there is a policy to that effect?

Senator Lang: Where does the weight lie? Is the government prepared to gamble on domestic R&D resources as opposed to proven foreign R&D resources?

Dr. LeClair: Again I think that is a question of policy. I must say, it is not that clear cut that I can tell you now what it is. You might want to ask the minister what it ought to be.

The Chairman: I wanted to ask some questions about the Interdepartmental Committee on Industrial Technology Policy. Here again you say that a lot of working papers have been prepared for that interdepartmental committee regarding existing industrial R&D assisted programs and the general issues of R&D industrial support. Then you conclude that these issues are presently under consideration. It seems to me that there are a lot of issues at present under consideration. I suppose the study you indicated a moment ago is part of this review.

Dr. LeClair: That is correct. This is under very active review. The study you refer to has been completed in the last few weeks. This committee is sitting. This may have something to do with the reorganization of MOSST. You will remember that MOSST reorganized itself very recently into three different branches, one of which was Industry. Dr. Meyboom, of this branch, has been with us now for three or four months. It is true that all these things are currently under review, but we are getting there. If you want some more information on the committee, perhaps Dr. Meyboom can tell you more about it.

The Chairman: Perhaps he will want to make a statement about it. However, before he does, let me say this. You say this committee is working in close association with another committee called the Interdepartmental Committee on Industrial Policies and Strategies. I wonder how close this association is in practice, and why there are two committees. It seems to me that we have quite a number of committees. The mandates of the two committees seem to be fairly directly related. You might have occasion to drop one of them. Do you want to comment on this?

Dr. Meyboom: The interdepartmental committee to review the support programs has been dormant for some time, for the very reason you have just described—namely, that its terms of reference seem to be somewhat similar to those of the Interdepartmental Committee on Industrial Policies and Strategies. In view of the fact that we have started this review, I felt it was not really necessary yet, although that committee exists on paper, to call it together at this stage. We are at work, and it may well be better to use the Interdepartmental Committee on Industrial Policies and Strategies as a more appropriate forum to review whatever we are finding rather than the somewhat more junior committee you referred to earlier. Thus, the very questions that have crossed your mind have crossed our minds. The reason is as I have explained, and therefore it would be fair to say that the first committee is dormant at the moment.

Senator Grosart: Which one is dormant?

The Chairman: The one on industrial technology policy.

Dr. Meyboom: Yes.

The Chairman: In our second volume we recommended that MOSST should offer grants to support a research

program in universities on the organization of R&D activities and on innovation strategy. We believed at that time, and we still believe, that such research is vital to the formulation of "a rational science policy", and it would certainly help industry to improve its innovative strategies and performance. I am wondering what has happened to that recommendation. I have not seen any reference to it in your brief. There is a program of research on research.

Dr. LeClair: MOSST has adopted a policy that we would not give grants. This is based on the fact that we should be completely neutral, and it would affect our credibility if we had a program of our own when we were recommending to Treasury Board whether it would be increased or not. The three councils have been meeting, as you know, for quite a number of years on a regular basis and trying to make sure that there are no gaps between the different programs.

The Chairman: I was not speaking about that. I was speaking about research on technological innovation, the conditions of success for innovation.

Dr. LeClair: You are not talking about grants; you are talking about contracts.

The Chairman: Grants or contracts.

Senator Grosart: Programs.

The Chairman: But on these specific issues.

Dr. LeClair: I am sorry, I interpreted your question as one meaning grants. If you are talking about contracts, MOSST has given contracts for this sort of thing. Perhaps Dr. Meyboom or Dr. Demirdache could say whether we have given contracts in this particular field. We have given contracts in technological assessment. You are talking about one on research on research.

Dr. A. R. Demirdache, Director, Technological Forecasting and Technology Assessment Division, Ministry of State for Science and Technology: We had one on research on research which was published.

The Chairman: You have made one study.

Dr. Demirdache: Yes.

The Chairman: The reason I ask that question is that the Department of Industry, Trade and Commerce has launched a program entitled "University Grants Program", which is exactly in line with our recommendation. It has already spent \$1 million under this program and it has received, according to the brief which is before us now, 41 reports on research in this area. I wonder if MOSST has had access to those reports and to what extent it has found them useful in carrying out its mission.

Dr. Meyboom: As a general answer, Mr. Chairman, I am not aware of that program. We are in touch with the Department of Industry, Trade and Commerce on a number of issues. That is one of the issues I have not been particularly familiar with. We have seen some reports, and I think I know what you mean. Some of the reports I have seen are probably related to this program and have to do with general studies on the nature of inventors in Canada, the psychology of innovation and what it is that makes one industry more innovative than another. Yes, from that point of view I must say that I have seen some of those reports, but certainly not the number of reports you have just mentioned.

The Chairman: You may want to look at the brief which has been sent to us by the department. The description of the program is in Appendix E of that brief.

Senator Grosart: Mr. Chairman, the Ontario Research Foundation tells us that—and I am quoting them directly:

At least ninety-five per cent of manufacturing and other industrial companies cannot benefit directly from this contracting-out policy, simply because they have no in-house R&D capabilities, and so are not in a position to bid on government jobs.

Is this so, that 95 per cent of all Canadian manufacturing and other industrial companies cannot benefit from the contracting-out policy? If so, who can benefit? Who constitutes the remaining 5 per cent?

Dr. LeClair: Mr. Chairman, Dr. Meyboom can answer that, but may I ask what definition of "manufacturing industry" the Ontario Research Foundation is using?

Senator Grosart: I do not know. It is the Ontario Research Foundation. They are fairly precise in their terminology.

Dr. LeClair: And how do they define "benefiting"? If you define it as meaning "able to receive grants", that is a different matter; but until we see the study itself and how they arrived at their conclusion, it would be difficult for us to comment on it. We have not done that particular study. Perhaps Dr. Meyboom can tell you whether it is in the right ball park, but, again, I would have problems with exactly what they are referring to.

Dr. Meyboom: If I may be so bold, Mr. Chairman, I think the Ontario Research Foundation is trying to marshal arguments why organizations such as theirs should have a much larger share in the "make or buy" policy.

Senator Grosart: Of course.

Dr. Meyboom: With respect to the figure quoted here, I cannot either challenge it or prove it. All I know is that if you look at Canadian research and development capability in industry, it is much, much larger—and I have had an argument with ORF on this issue—it is much larger than has been commonly assumed. When the Department of Supply and Services started implementing the "make or buy" policy, there were general advertisements in the newspapers in Canada saying that those industrial concerns that had R&D capability should kindly register in detail with the Department of Supply and Services. The expectation was that perhaps we would receive 500 or 1,000 replies to that general advertisement. The reasoning behind that was that if you look at the directory of R&D establishments in Canada published by the Department of Industry, Trade and Commerce at that time, that was about the number entered in that book. However, the result of the call by DSS was that about 3,000 companies in Canada established with DSS their R&D capabilities, and most of them were very respectable and very reputable. To say, therefore, that 95 per cent of Canada's manufacturing

and other industrial companies cannot profit from the "make or buy" policy, I think, is a somewhat exaggerated statement.

Senator Grosart: That is good news.

The Chairman: In your review of the scope of the "make or buy" policy, do you envisage the possibility of extending the application of the policy to the human sciences, for instance? I understand that at the moment it applies only to the so-called natural sciences.

Dr. Meyboom: It is being examined at the moment to see whether it should be extended. There is a hopeful sign, however, in that departments at the moment on their own are already contracting out for some human sciences, particularly as applicable to things like economics, the economic impact of certain regional studies or urban studies. Without specific policy directives at this time, which may or may not come about, departments are quite serious in contracting out already for the human sciences.

The Chairman: Do you also contemplate the possibility of extending the policy not only to R&D but to other scientific activities?

Dr. Meyboom: Mr. Chairman, quite naturally that is part of the recommendations we are examining at the moment. As you know, the Science Council in its annual report some time ago advocated that. Some other organizations have also advocated that. Quite clearly, it is something we will have to consider.

Senator Grosart: Would that explain the figure we have from table 4 which the chairman tabled, which deals with R&D grants which would take in some part of the comparatives? The figure for industry in 1975-76 is \$124.7 million, and for universities and non-profit sector, \$142.2.

The Chairman: I do not think it deals with grants; not the "make or buy" policy.

Senator Grosart: I emphasize that these are just grants, Mr. Chairman. Would this be the area to which Dr. Meyboom was referring, the extension into the humanities?

Dr. Meyboom: No, Mr. Chairman.

Senator Grosart: It is actually from the "make or buy" policy?

Dr. Meyboom: Yes. The figures shown here in large part are really Industry, Trade and Commerce programs plus IRAP of NRC. I am talking specifically about the contracting-out program.

The Chairman: It is not grants.

Senator Grosart: There are more professors in universities than there are in industry.

The Chairman: Maybe I will apply! Thank you very much, gentlemen. Presumably we will resume our activities at the same time next week.

The committee adjourned.

APPENDIX «14»

Canada's International Collaboration in Science and Technology.

It is understood that the Senate Special Committee is primarily interested in major bilateral activities. The attached list, although not exhaustive, includes those projects that involve Canada in significant levels of funding and manpower.

Senators will be aware that Canada also contributes to a wide variety of multilateral programs most of which come under the auspices of international agencies such as the UN, NATO and OECD. An example of such a program is the Global Atmospheric Research Program (GARP) under the World Meteorological Organization and the International Council of Scientific Unions.

Canada is also involved in a very large number of informal arrangements - primarily with the USA - involving information exchange, use of special facilities, exchange of scientists, etc.

MAJOR BILATERAL COOPERATIVE PROGRAMS IN SCIENCE AND TECHNOLOGY.

Programs involving primarily Canadian Industries.

1. Long Range Surveillance Drone.

Canadair Ltd and Dornier Systems (FRG)

2. Air Cushion Landing System.

DeHavilland and Pratt and Whitney (Canada)
Bell Aerospace (USA)

3. Augmenter Wing Development.

DeHavilland and Rolls Royce (Canada)
Boeing (USA)

The Federal Government focus for the above three programs is the Department of Industry, Trade and Commerce.

4. Teleoperator Remote Manipulator System (for NASA Space Shuttle).

Spar Aerospace, RCA (Canada), Canadian Aviation Electronics).
Dillworth, Secord and Meagher.
The US is represented by NASA.
The NRC is the Federal Government focus.

5. Communications Technology Satellite.

Spar Aerospace, RCA (Canada), (the vehicle).
US Company (travelling wave tube).
European Company (Solar Cells).
NASA (Launch facilities).

The University of Toronto was involved in spacecraft stability.
The Federal Government focus is the Department of Communications.

Programs involving primarily Canadian Universities.6. Deep Sea Drilling Project (1974)

Dalhousie University.
National Science Foundation (USA)
NRC funding.

7. Alpha Helix Expedition to Amazon River (1976)

(Bio-medical and Physical Scientific Studies)
University of British Columbia.
University of California (Scripps Institute).
Canadian funding through NRC.
US funding through NSF and NIH.

8. Cosmic Ray Studies in Australia.

Simon Frazer University.
Bristol Aerospace.
SED Systems Ltd., Saskatoon.
Australian Government.

9. Institute of Particle Physics (IPP).

Members are Canadian university researchers who
require use of high energy accelerators in other
countries, particularly in the USA.
University involvement: Carleton, McGill, UBC, Guelph,
Montreal, Ottawa, Toronto.
Source of funds: NRC.

10. Canada-France-Hawaii Telescope.

University and Government astronomers across Canada.
CNRS (France)
University of Hawaii (USA)
Canadian funding through NRC.

11. Studies of Magnetospheric Cleft (1974, 1975).

York University
NRC Laboratories.
Energy Research and Development Administration (ERDA), USA.
Rocket Launching at Cape Parry, NWT, by
Bristol Aerospace Ltd.
Canadian funding through NRC.

Programs involving primarily Federal Government
Departments and Agencies.

12. LANDSAT (Earth Resources Technology Satellites).

Canada Centre for Remote Sensing (EM&R)
NASA.

13. Sensor Development for physical oceanographic measurement.

Bedford Institute of Oceanography (Department of Environment)
Kiel University (FRG)

This project comes under the Canada-Federal Republic
of Germany Science and Technology Agreement.

14. Forest-Based Industries Working Group.

Canadian Forestry Service (DOE)
IT&C, Provincial Governments and Forest Industries.
USSR.

This project comes under the Canada-USSR Agreement
on Industrial Application of Science and Technology.

APPENDIX «15»

TABLE 1: TOTAL FEDERAL EXPENDITURES ON SCIENTIFIC
ACTIVITIES BY PERFORMER

	On a Percentage Basis										
	1967-68	68-69	69-70	70-71	71-72	72-73	73-74	74-75	75-76		
In-House	68.3	65.2	64.3	62.9	63.4	64.9	62.9	63.0	63.8		
Industry	15.1	16.7	16.4	19.5	18.8	17.9	18.7	17.8	16.9		
Universities and Non-Profit Sector	15.7	16.9	18.3	16.7	16.5	15.1	15.3	14.6	14.7		
Other Canadians	0.3	0.4	0.2	0.4	0.4	0.8	0.6	0.9	0.8		
Foreign	0.4	0.6	0.6	0.5	0.9	1.2	2.4	3.5	3.6		

Source: Statistics Canada

TABLE 2: TOTAL FEDERAL EXPENDITURES ON R&D BY PERFORMER

On a Percentage Basis

	1967-68	68-69	69-70	70-71	71-72	72-73	73-74	74-75	75-76
In-House	62.4	58.3	57.0	54.4	55.6	56.4	55.4	55.8	57.3
Industry	18.7	20.7	20.3	24.5	22.5	22.1	23.1	23.0	21.5
Universities and Non-Profit Sector	18.1	19.6	21.6	20.1	20.4	19.2	18.7	17.5	17.5
Other Canadians	0.3	0.5	0.2	0.2	0.3	0.4	0.7	1.2	1.0
Foreign	0.3	0.7	0.7	0.6	1.2	1.6	1.9	2.4	2.5

Source: Statistics Canada

TABLE 3: CURRENT FEDERAL EXPENDITURES ON R&D CONTRACTS

	In Millions of Dollars		
	1973-74	1974-75	1975-76
Industry	50.6	54.9	63.4
Universities and Non-Profit Sector	4.8	6.2	8.4
Other Canadians	1.4	3.1	4.0
Foreign	2.8	5.1	4.3

Source: Statistics Canada

TABLE 4: CURRENT FEDERAL EXPENDITURES ON R&D GRANTS

	In Millions of Dollars		
	1973-74	1974-75	1975-76
Industry	121.3	125.8	124.7
Universities and Non-Profit Sector	122.8	128.9	142.2
Other Canadians	3.7	6.2	4.7
Foreign	5.5	10.8	14.5

Source: Statistics Canada



Government
Publications

FIRST SESSION—THIRTIETH PARLIAMENT

1974-76

THE SENATE OF CANADA

PROCEEDINGS OF THE
SPECIAL COMMITTEE OF THE SENATE ON

SCIENCE POLICY

The Honourable MAURICE LAMONTAGNE, P.C., *Chairman*

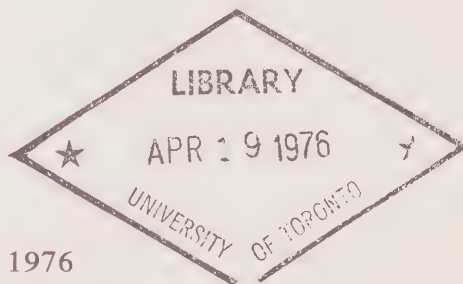
Issue No. 5

WEDNESDAY, MARCH 10, 1976

Fifth Proceedings on:

“The Study of Canadian Government and
other expenditures on scientific activities
and matters related thereto.”

(Witnesses and appendices: See Minutes of Proceedings)



THE SPECIAL COMMITTEE OF THE
SENATE ON SCIENCE POLICY

The Honourable Maurice Lamontagne, P.C., *Chairman*

The Honourable Donald Cameron, *Deputy Chairman*

AND

The Honourable Senators:

Asselin	Hastings
Bélisle	Hicks
Bell	Lang
Blois	Manning
Bonnell	Neiman
Bourget	Riel
Buckwold	Robichaud
Carter	Rowe
Giguère	Stanbury
Godfrey	Thompson
Goldenberg	van Roggen
Grosart	Yuzyk
Haig	

27 Members

(Quorum 5)

Order of Reference

Extract from the First Report of the Special Committee of the Senate on Science Policy, presented on July 10, 1975 and printed as an Appendix to the Minutes of the Proceedings of the Senate of that day, and adopted by the Senate on July 24, 1975:

"The Committee, therefore, recommends that it be authorized to consider and report on Canadian government and other expenditures on scientific activities and matters related thereto;

That the Committee have power to engage the services of such counsel and clerical personnel as may be necessary for the purpose of the inquiry;

That the Committee have power to send for persons, papers and records, to sit during adjournments of the Senate and to report from time to time; and

That the Committee be authorized to print such papers and evidence from day to day as may be ordered by the Committee."

Robert Fortier,
Clerk of the Senate.

Minutes of Proceedings

Wednesday, March 10, 1976
(14)

Pursuant to adjournment and notice the Special Committee of the Senate on Science Policy met this day at 3:30 p.m., the Chairman, the Honourable Senator Lamontagne, presiding.

Present: The Honourable Senators Bélisle, Bell, Bonnell, Bourget, Carter, Godfrey, Grosart, Haig, Lamontagne, Lang, Manning, Neiman, Robichaud and Rowe. (14)

In attendance: Mr. Philip J. Pocock, Director of Research.

The Committee resumed consideration of its Order of Reference dated July 24, 1975 relating to the study of Canadian Government and other expenditures on scientific activities and matters related thereto.

The following witnesses were heard:

The Honourable C. M. Drury,
Minister of State for Science and Technology;
Dr. M. J. LeClair,
Secretary to the Ministry of State for Science and Technology.

The Chairman made a short statement during which he tabled a document entitled "Total Federal Expenditures on Scientific Activities by Performers, 1970-71—1976-77". It was *Agreed* to print this document as an appendix to today's Minutes of Proceedings and Evidence. It was further *Agreed* to print as an appendix to today's Minutes of Proceedings and Evidence, Page 58 of the booklet entitled "76-77 How your tax dollar is spent", issued by Treasury Board. These are printed as appendices numbers "16" and "17" respectively.

During the course of the meeting, the Minister and his Official answered questions put to them by Members of the Committee.

At 5:42 p.m. the Committee adjourned to the call of the Chairman.

ATTEST:

Patrick J. Savoie,
Clerk of the Committee.

The Standing Senate Committee on Science Policy

Evidence

Ottawa, Wednesday, March 10, 1976

The Special Committee of the Senate on Science Policy met this day at 3.40 p.m. to consider Canadian Government and other expenditures on scientific activities and matters relating thereto.

Senator Maurice Lamontagne (*Chairman*) in the Chair.

The Chairman: Mr. Minister, I wish first to apologize for our not being able to hear you last week. We all believe in forward planning, I think, but very often in real life it does not work. It did not work for us last week so, again, on behalf of my colleagues and myself I wish to apologize for this, not only to you, but also to all your associates.

In order to pursue this matter, honourable senators will remember that at our last meeting with the minister I distributed a certain statistical table, among others, showing the total federal expenditures on scientific activities by performers. Since then the publication "How Your Tax Dollar Is Spent, 1966-67" has been released and on the basis of the revised and more recent figures it contains I have prepared another table showing total federal expenditures on scientific activities by performers on a percentage basis for the fiscal years from 1970-71 to 1976-77. I propose to have this other table printed as an appendix to today's proceedings.

(*See Appendix No. "16"*)

Most members of the committee and the minister have already received this table, which is simply a translation, on a percentage basis, of the figures which appear in "How Your Tax Dollar Is Spent". You will notice that this table shows that during this period of seven years the share of the government performance sector has increased consistently from 61.1 per cent to 66.7 per cent, and that the share of the residual sector, mainly due, I understand, to foreign performers, has also risen, from 3.3 per cent to 6.8 per cent. On the other hand, the share of Canadian industry has declined from 18.4 per cent to 13.7 per cent, and that of Canadian universities from 17.2 per cent to 12.8 per cent. I believe that these new figures reveal an even more distressing trend than those I had presented at our last meeting.

Senator Carter: Before you leave that table, does the total represent total federal expenditures?

The Chairman: Yes.

Senator Carter: Taking the last column, 1976-77, when you say federal expenditures, do you mean all the national expenditures?

The Chairman: Yes, on scientific activities. It is total federal expenditures on scientific activities.

Senator Bélisle: Mr. Chairman, may I ask a supplementary: Regarding the universities' decline from 17.2 per cent

to 12.8 per cent, you are only referring to the money that was funded by the government to the universities?

The Chairman: Exactly.

Senator Carter: That was also my point.

Senator Manning: Mr. Chairman, do you have this given in dollar figures also?

The Chairman: No, I have those figures in this booklet which was issued by the government when the main estimates were tabled. It is entitled "How Your Tax Dollar is Spent". It is at page 58.

Senator Manning: I just wondered, if this is going to be an appendix, if it would not be more meaningful in that context for the dollars table to be included.

The Chairman: We might just print another table, reproducing those figures.

As far as I am concerned, at least, one point of confusion has remained in my mind since the last meeting with respect to the "make or buy" policy. Am I wrong in inferring from previous statements that the "make or buy," policy as it now applies to new programs in the area of natural sciences, has reached its full potential and that in 1976-77, for instance, 100 per cent of the new programs covered by that policy will be contracted out?

The Honourable C. M. Drury, Minister of State for Science and Technology: You are wrong, Mr. Chairman.

The Chairman: I was given to understand—and I don't know if it was during or after our last meeting, not by you but by someone else—that this potential had been fully met, more or less.

Hon. Mr. Drury: When you say the "potential," I would not agree that the "make or buy" policy has reached full flower and that it has no possibilities of further or continuing success. We would expect to get more of the good results that it is designed to produce in the future.

The Chairman: But by extending its coverage.

Hon. Mr. Drury: When you say "by extending its coverage", do you mean by modifying it, then, in some manner?

The Chairman: Yes.

Hon. Mr. Drury: We have no present intention of modifying its terms, but do hope to make it more effective, perhaps, than it has been.

The Chairman: I understood, first, that this policy was under review at the moment, with the objective of extending its coverage. That is indicated in your brief.

Hon. Mr. Drury: Maybe we should ask Dr. LeClair to elaborate. Mr. Chairman, you made reference to the natural sciences?

The Chairman: Yes.

Hon. Mr. Drury: As you know, the "make or buy" policy has not been given much effect in relation to either the human sciences or to some degree, in respect of what are known as science-related activities. We would hope that this philosophy would be extended to these two areas, but this has nothing to do with the natural sciences as a limited category. To date we have been concentrating on the application of the "make or buy" policy in respect of all new research projects and so-called fresh money. We will have, now that the amounts of new money, additional money for all government purposes, are limited, to turn our attention to the application of the "make or buy" policy to existing programs, with a view to seeing whether advantage can be achieved through shifting existing programs from intramural to extramural programs. One of these in which this is in the process of being done, (i.e. switching an existing program) is in relation to the testing of airborne or satellite-borne environmental sensors.

The Chairman: I would like to return to my initial question and ask again: Is it true that the "make or buy" policy, as it is at the moment, has more or less exhausted its potentialities for transfer?

Hon. Mr. Drury: The answer to that is no. Obviously, if we are going to limit it only to new money . . .

The Chairman: That is what I mean.

Hon. Mr. Drury: Further potential this year does not substantially exist. We have reviewed the whole lot, and where we have been able to, in respect to all new money, it has been contracted out. Insofar as potential for more effectiveness, this will depend on transferring of existing policies from intramural to extramural and an extension to the human sciences.

Senator Carter: I would like to follow up on that point. This 60 cents on the dollar that you are spending this year is being spent on projects which will, it seems to me, come to an end. These are not all going on for all time, these in-house projects on which you are spending money now. Is it your policy that as the project is completed the new money that comes in will be diverted into industry, or is the in-house going to go up indefinitely, as it has from 1971 to 1976?

Hon. Mr. Drury: No, it would be our hope that this tendency shown by the figures to which you made reference, namely, a continuous proportional increase of in-house and a continuous proportional decrease of extramural, will reverse. Unfortunately, while the "make or buy" policy is something with which I think everyone agrees, it does not mean that, of necessity, every project should be extramural, and some quite large ones are better conducted within the government, as intramural, than outside. I might mention, as an example, the telescope now under construction at quite substantial cost on the island of Hawaii, jointly with the French. The French government has organized this on a public or governmental basis of ownership and operation and would want—in fact, they did want—the Canadian side of it to be governmental for ownership and operation. In this sense, that very substantial expenditure is all in-house.

Senator Carter: That particular example is understandable. No private company could invest in the instruments you need for that type of research. Let us take agricultural research, industrial research, and biological research into animals. A lot of that work can be done just as well outside as inside. Do you have any policy to tap off the in-house research in those fields, in fields where it can be done, so that it can expand extramurally?

Hon. Mr. Drury: A policy of moving it out of house has been one we have been following, and indeed, as Dr. LeClair indicated at the last meeting, for the current year all new projects, all new money, will be rigorously tested to see whether there is any reason at all why it should not be done outside. I merely cite the telescope. If that particular project had arisen this year, despite applying to it the test and criteria of the "make and buy" policy, it still would have ended up as an intramural operation.

Senator Lang: Why is that? Because that French insisted upon it?

Hon. Mr. Drury: To a large degree, the French, who are putting up half the capital cost, insist upon it, and there does not exist any private, non-governmental body to undertake the necessary negotiations with a number of other governments, including the government of the United States, the territorial government of Hawaii, and the government of France.

Senator Grosart: Do you not think, Mr. Minister, that if industry were given the opportunity to put together a consortium they would do it?

Senator Lang: Couldn't NRC or someone do that in negotiations with other governments?

Hon. Mr. Drury: NRC is doing it.

Senator Lang: That does not mean that they have to do all the R&D work. They could do the negotiations with the various governments, and the R&D could be done elsewhere.

Hon. Mr. Drury: When you say "the R&D work," the design was contracted out, the construction was contracted out; but it is still reflected here, even though virtually everything except the negotiations was done by private industry. The money was public money, federally spent, and spent at the discretion of the public authority, not at the discretion of the private authority.

Senator Grosart: This would not affect these figures. These are by performer, not by the funder, so the decline that is indicated here has fooled a lot of people, including NRC, who said in their redefined role statement of 1974:

In recent years it has been the national policy to restrict growth of R&D activity in the government and university sectors and to accord higher priority to industrial R&D.

Even the NRC believed this fiction. They say it has been the policy, and it has not happened. This is in recent years. It cannot have been the policy when we end up with these figures.

Hon. Mr. Drury: Senator Grosart, you say, in connection with the telescope, that the performer of the work has been the private sector . . .

Senator Grosart: Yes.

Hon. Mr. Drury: —but the amounts of money spent on that appear under the heading "Intramural."

Senator Grosart: If that is so, Mr. Minister, these figures are absolutely worthless, because they imply, "by performer," the person who performs the work; and if that is industry, it would show here, in my submission, in the industry figure. It is not a statement of who puts up the money. This is a statement by Statistics Canada of who performs. These definitions have been with us for years. There is not the least doubt about that statement.

Hon. Mr. Drury: Let me take issue with this. Are you suggesting that when the National Research Council built the wind tunnel for \$9 million, under the heading of "performer" we put an expenditure of \$9 million paid to the private contractor to build it, and that that comes under the heading "\$9 million for industry" in these figures?

Senator Grosart: It should, if it is by performer. The definitions that Statistics Canada gives us would suggest that they are saying who performs the work. If that is not so, the figures are worthless.

The Chairman: We have other figures showing the distribution on the basis of funding. The distribution is different.

Hon. Mr. Drury: I am afraid that in relation to capital expenditures there may be some confusion. Pencils bought by the NRC and used in an experiment would be charged to the Eagle Pencil Company. That is an industrial performer of that research; but that is not the way it goes at all.

Senator Grosart: Buying pencils is not doing research in industry.

Hon. Mr. Drury: Building the concrete foundations for a wind tunnel is not doing research either.

Senator Grosart: These are scientific activities. Surely, if this is so, then Statistics Canada need to be told the meaning of "performer". If what you say is so, then these figures are worthless.

Hon. Mr. Drury: I do not think they are worthless, if one understands what they are.

Senator Grosart: One understands that "performer" does not mean performer!

Hon. Mr. Drury: Perhaps some confusion arises because in these figures there is no breakdown between capital and operating. When we are talking about operating expenditures, performer is of some significance; but when you get to capital, the performer is deemed to be the man who pays, and he is going to have the control of the capital object.

Senator Grosart: We will have to get back to Statistics Canada, to get them to rewrite all their figures and tell us what they mean by "performer," because a performer is someone who does a piece of work. In any English definition that I know of, a man who does the work is the performer, not the man who pays for it. Surely, we have to revise our whole conception of the English language if that is so. I will leave it, because you have raised the point.

The Chairman: We can verify that. It has been our impression over the years, that when we had a distribution by performers it meant that industry was the performer; it was not necessarily financing the project.

Senator Grosart: This is supported by the definitions I have read and by Statistics Canada. Until we find that out, I will abandon that line of questioning. How is government going to fulfill its policy of increasing the role of industry as a performer if we are reducing such programs as PAIT and DIP and abandoning IRDIA?

Hon. Mr. Drury: The fact that the trend shown by the table that the chairman has presented is in a direction opposite to the one which I think we all want indicates that the existing programs are not being successful. The results certainly do not indicate success. So this clearly calls for a review of those programs to find out why they are not being successful so we can change them to make them successful. These are all programs to provide public incentives to bring about a greater degree of innovation within and by manufacturing industry in Canada than has been the case in the past. To this end incentives are offered. The fact that they have not been taken up to the point where we have no money left means that they are not attractive and are not accomplishing the purpose sought.

The Chairman: But did you not receive quite violent opposition to the abandoning of IRDIA from industry?

Hon. Mr. Drury: Yes, and one would expect that. There are some people who have found IRDIA useful. I do not question that. But what we are trying to find out is what are the real reasons for the opposition. I think many of you will be familiar with the kind of response there is to a proposal to abandon the operation of a railway station in a small community. There is some quite violent opposition to such a suggestion. But no one is able to find the one man who used the train. There are many other people to object, and to some degree this is the case or IRDIA. If it had been effective, these figures would have gone in the opposite direction.

The Chairman: Not necessarily, because if you have a limited amount available for the purpose of these programs, and if you go on increasing the budget of government labs, you will get those kinds of figures just the same by government decision.

Hon. Mr. Drury: Well, I may say, Mr. Chairman, that IRDIA is a tax incentive program where there is no question of limited sums of money. The amounts of money are completely at choice. So that observation does not apply to IRDIA. In respect to the other programs there has not been pressure on the amounts annually allocated on a national basis as being available. We have never had, to the best of my knowledge and insofar as I can recall, to go to Parliament for supplementary money in respect of these particular incentive programs such as PAIT. The programs where the amounts of money are clearly limited tend to result in supplementary estimates.

Senator Grosart: Some time ago the Department of Industry, Trade and Commerce announced to industry and to others that they had 11 great programs of incentives for research, development and innovation. You have mentioned three of them—one abandoned and two substantially reduced. What about the rest of them? Have they all been failures? Has any one of them been a success? Here I am speaking of AAAP, BEAM, GAP, IDAP et cetera—Has any one of them—and they were the essence of government policy for the funding of research development and innovations—been successful? You have mentioned three that have not been.

Hon. Mr. Drury: These incentive programs by the Department of Industry, Trade and Commerce tend to be quite numerous and cover quite a wide spectrum of clients and quite a wide spectrum of innovative processes, and the degree of success varies. We are currently reviewing them and it would be a little casual of me either to make sweeping generalizations that they are all successful or that they are all failures, or to pretend to know something I do not know. It would be a little presumptuous on my part, before the review is undertaken, to tell you what the results are going to be.

Senator Grosart: The Science Council has recommended that "national priority be accorded to the support of science and technology in industry". Will that happen? Will the government accept that recommendation?

Hon. Mr. Drury: I am not quite sure of the significance of this. If the question is whether the government recognizes that science and technology are important and useful in the accomplishment of objectives, the answer would be yes. So, I can answer yes to that question.

Senator Grosart: But the Science Council says that technology-based industries are important to the whole economic future of the country, and I think we all know that because it is high technology products that are the premium items in world markets especially now given our concern with exports. It would seem that when the Science Council says that "our technology-based industries are in difficulty" we have to wonder whether our science policy, as it has existed in the last few years, has been effective, whether it could have been more effective in the past, and whether it will be more effective in the future. This a vital question for Canada and we are searching for these answers, as I am sure MOSST is and others are. Can you give us any information as to the prospects of our getting out of this bogdown in which we find ourselves in the development of our technology?

Hon. Mr. Drury: Senator Grosart, you made the statement that our technologically-based, high technology industries are currently in difficulty.

Senator Grosart: That is the Science Council's statement, not mine.

Hon. Mr. Drury: But you subscribe to it, I hope.

Senator Grosart: Yes, I do.

Hon. Mr. Drury: So do I. The question is, "Why?" One of my personal prejudices in the answer to that question is that our difficulties lie in our lack of marketing capacity and marketing skills and marketing organization, rather more than inadequate technological capacity either in research, development, manufacturing or delivery stage. Perhaps as an example of this I might cite the celebrated "Arrow," where Canadian aeronautical engineers were able to design an original design, Canadian manufacturers were able to produce efficiently on a cost competitive basis in military aircraft which was considerably in advance of the state of the art anywhere in the world, but which was no success.

Senator Grosart: We did not employ Lockheed to do the marketing!

Hon. Mr. Drury: The cure to Arrow's problems, I would suggest, would not have been to say, "We have to put in more money for science and technology."

Senator Grosart: The answer may be to put it in the right place, of course.

The Chairman: Let us go back a bit. Instead of reviewing the situation of industry at the moment, could we not have a review of the efficiency of government assistance programs to make industry more innovative? There is considerable empirical evidence, for instance, that the innovative performance of industry is improved the most when industry can perform the research and is free to choose its own projects. From that point of view, it would seem to me that tax incentives would be much more effective than grants; that grants would be much more effective than contracting out, because when you contract out you impose your project on industry; and that the least effective way of assisting industry is to do research in-house in government laboratories. From that point of view, if this empirical evidence is right, it seems to me that the priorities...

Hon. Mr. Drury: Just a moment, Mr. Chairman. Surely, to be correct, that is not empirical evidence; it is merely a theory.

The Chairman: No. We have quoted empirical studies in volumes 2 and 3 and we could quote all kinds of other surveys which have been made in the United States and in other places which show exactly the kinds of priorities I have just listed.

Hon. Mr. Drury: Well, we have had tax incentive programs for a number of years; we have had grant programs; we have had contracting out and we have had intramural programs.

The Chairman: Yes.

Hon. Mr. Drury: For some reason or other the relative growth has been intramural, not because it was desired as a matter of policy but, one might say, because that is what happens when one offers a menu to the participants. That is how it got taken up. Industry apparently did not like the menu.

The Chairman: The menu very often was not available to them.

Hon. Mr. Drury: When you say it was not available, it was supposed to be available. I do suggest that in some cases what we were offering was pheasant under glass to a man who was on a salt-free, milk-only diet. To this extent the menu perhaps was inappropriate, but one tried to overcome that by at least an alphabet menu—a pretty big one.

Senator Grosart: "Alphabet soup."

The Chairman: In any case, you have said again that it is your objective to try to change this situation and that all these government programs are under review. On this last point I am confused by the number of reviews which are going on, and I wonder what kind of co-ordination is taking place in this area so that some consensus among various government agencies could be arrived at. For instance, I understand that MOSST has made its own review of these programs and that that review was presented to the interdepartmental committee on industrial and technological policy some time last year. That is one review.

Hon. Mr. Drury: I am told the review to which you make reference is still underway and that there has not been a conclusion to it.

Senator Grosart: Is industry participating in this? The number one recommendation of the Science Council was that this review of industry support policy should have participation by industry. To what extent is industry involved in this review?

Hon. Mr. Drury: The department basically concerned with the conduct of this review is, of course, the Department of Industry, Trade and Commerce. In the review of industrial innovation and the programs for it, there is no participation by the Department of Agriculture. They have really a different set of problems, even though there are frequent references to the agriculture industry. It is really quite a different problem, a different environment from secondary industry in Canada.

The Chairman: I understand that the Department of Industry, Trade and Commerce has been making its own review of these programs.

Hon. Mr. Drury: That is correct.

The Chairman: Has this review been communicated to MOSST?

Hon. Mr. Drury: We are familiar with it, it is not yet complete, but it is not a review by MOSST. Basically, the responsibility for it rests with the department looking at itself.

The Chairman: I would assume that the Department of Industry, Trade and Commerce would communicate its views to MOSST in this whole process of review.

Hon. Mr. Drury: They are.

Senator Grosart: They tell you about it. They tell you they are doing it, normally.

The Chairman: Then the Department of Industry, Trade and Commerce has appointed a special consultant, Mr. Gordon Sharwood, who has been working on the review of the review since last October, I understand. I have seen that in the press.

Hon. Mr. Drury: Yes, I think probably Mr. Sharwood is rather undertaking, with very little in the way of resources, an overview or his own review.

The Chairman: Then Treasury board, in the planning branch, has made its own review, I understand also.

Hon. Mr. Drury: Treasury Board, in the planning branch, is continuously reviewing all kinds of activities, some general and others specific. That is their work.

The Chairman: But they have made a specific review of this particular problem.

Hon. Mr. Drury: If they have, I am not aware of it, other than the annual work they do.

The Chairman: In any case, we have three government agencies making reviews and one consultant making an overview, and I wonder when all of these people will come together to form a proper strategy and a proper policy in this area, which you agree is vital for the future of our country.

Hon. Mr. Drury: When will we be in a position to examine the analysis which is now being made? I am told, Mr. Chairman, that within a few weeks we should, as a government, be looking at the industrial innovative policies.

Senator Grosart: Maybe someone should tell the pitcher that there is a runner on second base.

The Chairman: Before it becomes a formal government policy, will there be any opportunity for parliamentarians, for instance, to look at these studies and reviews?

Hon. Mr. Drury: Some of them, Mr. Chairman, I think will be published; others not.

The Chairman: But finally there will be a kind of white paper, or coordinated presentation, I would hope, which would synthesize all the new government programs. I would hope, as a parliamentarian, that this official study, before it becomes government policy, would be submitted to some kind of examination and that industry and parliamentarians, in particular, would have an input to make before these recommendations become formal policies. It would be highly desirable.

Senator Grosart: I do not think that my question as to whether industry participates in any of these reviews has been answered. Is industry itself called in and participating? In my opinion, this is particularly important in view of the minister's statement that the menu that was served up earlier was not attractive to industry.

Hon. Mr. Drury: There is no formal industry participation in the sense that this is a review being carried out by a joint government-industry committee. There is no question but that the consultant to whom reference has been made and the Department of Industry, Trade and Commerce are talking to and consulting with people in the industrial field. The officials operating these various programs are consulting with the industrial sector with which they are concerned.

Senator Grosart: I think you and I would believe the way to do it would be to call in industry and ask, "If we do this, will you undertake to do that?" I cannot understand why we have not done this—say to industry, "What do you want, and what do you guarantee to do? And if you do not do it, shut up". If there is no participation by industry in these reviews, I cannot see how we came up with a better menu next time.

Hon. Mr. Drury: I would agree with you that if there is no consultation with industry...

Senator Grosart: I mean participation, not just consultation.

Senator Godfrey: I am a little confused. Would you mind explaining the difference?

Senator Grosart: There is all the difference in the world. If I consult someone and ask his advice with respect to a project I have, or an aspect of the project, it is very different from him participating in the project. Taking advice is one thing, and participating is another.

The Chairman: Looking at the menu is something, and preparing it is something else.

Senator Godfrey: It is possible to ask what a person thinks of this project and what was experienced in the past as it is being reviewed. You can go around and ask people,

and that is what I understand that Mr. Gordon Sharwood is doing. Surely, they are to that extent participating in the review?

The Chairman: I understand that Mr. Sharwood is not doing this; he just makes his own appraisal.

Hon. Mr. Drury: He is consulting with people in industry.

Senator Godfrey: Yes, that is what the minister says and that is what Mr. Sharwood tells me personally.

Senator Grosart: I am quite sure, Mr. Minister, that there are many in this room who have been consulted on political decisions who would not say, when their advice was not taken, that they participated in the decision.

Senator Godfrey: I recognize that.

Hon. Mr. Drury: Yes, now what you are talking about is a negotiation, securing a commitment.

Senator Grosart: "Participation" is just taking part; it is a simple word.

Hon. Mr. Drury: "Discussion" is a form of taking part.

The Chairman: I think we should bring this discussion to a conclusion, but before I do so I would like to ask the minister again if there will be an opportunity—you attempted a few minutes ago to say "yes" by nodding your head—I would like you to confirm that there will be this type of opportunity to review the reviews by parliamentarians.

Hon. Mr. Drury: I am not quite sure, Mr. Chairman, of what I might term the useful mechanics of this. In the ordinary course of events the launching of a particular incentive program does not go before a parliamentary committee before it is launched.

The Chairman: We have several examples of government programs which have been published in terms of white papers, green papers, yellow papers, before they became formal government policies. I do not see why in this vital area we should not use that technique in order to get some positive participation, instead of criticizing you after the fact.

Senator Grosart: In fact, all bills, which are the essence of government policy, go to committees.

Hon. Mr. Drury: And the committees, anyhow in the House of Commons, are now staggering under an overload.

Senator Grosart: Could I ask the minister if there is any suggestion Canada will soon cease to be the only OECD country said not to have a science and technology committee in the elected house?

Hon. Mr. Drury: I would have to consult the Speaker about that.

Senator Manning: Is there any consultation with the provincial scientific and research bodies, in addition to industry, in this area of which you speak?

Hon. Mr. Drury: The answer to that is yes. When one refers to "provincial scientific bodies"...

The Chairman: I suppose Senator Manning was referring to the provincial research organizations, foundations and councils, such as the Ontario Research Foundation.

Senator Manning: Yes, sometimes in universities there are rather extensive establishments.

The Chairman: Do you mean the one in Alberta?

Senator Manning: Yes.

Hon. Mr. Drury: A case in point is that these exist in a fairly advanced state of development in Ontario, British Columbia and Alberta—they tend to be rather embryonic in other provinces—such as the Ontario Research Foundation type of institution. In the province of Quebec, for instance, the universities themselves are very much more effective in the research field than any governmental institution.

Senator Manning: I was thinking, Mr. Chairman, of the importance of a degree of coordination in these efforts. If I understand you correctly, at the present time the government of Alberta has established an approximately \$100 million fund for research, particularly into the tar sands processing and so on. It would be unfortunate, in my opinion, to see a research project of that magnitude go ahead without very close coordination with the national and international interests in the whole energy field.

Hon. Mr. Drury: I do not know the details of that, but I would be very surprised if the Department of Energy, Mines and Resources, which is the department primarily concerned in this field, is not fully aware of, and making the greatest possible use of, the Alberta Research Foundation and the fund available for petroleum research.

Senator Grosart: Mr. Minister, did I understand you to say that universities are more effective in conducting research than government institutions? I may have misunderstood you.

The Chairman: So far as the province of Quebec is concerned.

Senator Grosart: Only so far as the province of Quebec is concerned. I was wondering if you included the 66 per cent inhouse research.

Senator Carter: Before leaving this area, Mr. Chairman, I wonder if the minister could tell us if the menu we have been talking about was presented to industry before the government made its own selection.

Hon. Mr. Drury: The menu of which I speak, which is the alphabet menu, has grown up over quite a period of years. The degree of prior consultation and its administrative modification has involved a continuous interchange with industry.

Senator Carter: It was not developed with industry's participation, though, in terms of what it could do and what you would like it to do? These programs were dreamed up by the government, which then asked the industry to fit them in.

Hon. Mr. Drury: No. I can speak of one of which I have some personal knowledge, and that is the tax incentive program, IRDIA, concerning which there was extensive consultation with the high technology, innovative sections of our industry before being introduced.

Senator Grosart: Speaking of tax incentive programs, would you say there was consultation with industry before the self-generating tax incentive program that existed in the early 1960s was discontinued? The Science Council

again recommends that we get back to that kind of self-generating tax incentive program. We washed it out suddenly. Industry was very distressed by that decision and has made repeated requests that we return to that type of incentive. Is there any consideration being given to doing that?

Hon. Mr. Drury: It is, obviously, one of the alternatives to the present program. I think probably we would want to know a little more about the reasons for only limited success of the existing programs before deciding on new programs.

Senator Godfrey: This review that is taking place, is that also to find out whether or not industries receiving grants would have gone ahead, in any event, and whether, therefore, they are simply hand-outs? Is there any evidence to that effect?

Hon. Mr. Drury: As in the case of almost any incentive program, there will be instances where the incentive is the governing factor. In other words, it is only because of the fact of the incentive that something has been done, or not been done, as the case may be.

There will be other cases where it is just in the nature of a windfall. It is the hope to have a program which will produce, if not an absolute absence of windfalls, at least the barest minimum—this is one of the criteria for its usefulness and goodness—not merely one which provides resources or money to people for doing what they were going to do, anyway. Unfortunately, this calls for quite a degree of judgment—judgment which is, at times, fairly subjective. It is one of the things, I think, that no one really very much likes, whether it be the person judging or the person being judged.

As the Chairman has pointed out, the kind of program that people would prefer is where the incentive is self-generated and not subjected to this kind of judgment. What we have to try to do is produce real incentives, without which people will not embark on the desired research, but an incentive which is self-generated, self-administered, thereby avoiding this subjective judgment which might result in the decision that because you were going to do it anyway you are not going to get a grant and the next fellow, because he is better at writing a brochure, or whatever, gets paid for doing what he was going to do anyway.

Senator Grosart: Someone who is good at grantsmanship.

Hon. Mr. Drury: Yes.

Senator Lang: The Department of National Revenue seems to lack some capacity in assessing returns under these income tax incentive programs, does it not?

Hon. Mr. Drury: Its task, really, is to ensure that the expenditures made do in fact fall under the classification that is entitled to the incentives. Some of these are pretty esoteric. It is quite true that there are not many nuclear physicists on the staff of National Revenue, and they are, of course, quite properly, inhibited in terms of seeking outside advice, even technical advice, because of the confidentiality of the whole income tax return system. This is a continuing problem. There is no question about it.

The Chairman: Perhaps we can proceed now to section G, which commences at page 27 of the minister's brief. This section deals with government in-house industrial R&D.

In our report, Mr. Minister, we recommended that government labs involved in industrially-oriented R&D be brought together under a new Crown agency, with strong industrial representation on its boards and committees and a growing industrial contribution to its financing, which agency would be responsible to the Department of Industry, Trade and Commerce.

Your brief states that this recommendation "implied massive and complex organizational and operational issues," one of them being the "difficulty of deciding what aspects of R&D are separable from the mission of a department without destroying its operational capability."

I do not accept that our recommendation "implied massive and complex organizational and operational issues." I do not accept that criticism. I think that there are government labs with an industrial mission within government departments which have very little to do with the mission of the department. I wonder if it would not be possible to think again about this proposal. I have in mind, for instance, the forest products labs, in the Department of the Environment. I am sure they have nothing to do with the mission of the Department of the Environment. Yet they are very far from industry, which they are supposed to serve. It seems to me that kind of proposal made in our report, to bring all these labs together, had some value. The government could have implemented this recommendation gradually and slowly, as it usually does; but it seems to me that this proposal still has some merit.

Hon. Mr. Drury: Should the laboratories, which are quite extensive, of the Energy, Mines and Resources—the metallurgical laboratories—be taken away from them and put under another agency?

The Chairman: This is the kind of thing we wanted the government to examine as a proposal. Did you examine it? I recall very well, when we had our first series of hearings, that it was said that the metallurgical labs were not very useful for the industries they were designed to serve. That appears in our proceedings of 1968 and 1969. It might be desirable to change the umbrella organization within the government to which these labs are responsible. I wonder if a serious study of this has been made. I know more about forest products labs, which are under Environment. I recall that when I was Assistant Deputy Minister of Northern Affairs, I was responsible for those labs. They were not serving any useful industrial purpose. I wonder what kind of direct relation there is between the function and the role that these labs should fulfill and the mission of the Department of the Environment.

Hon. Mr. Drury: I would agree generally that a department should have the control of the laboratories which are responsible for, or working towards, the accomplishment of the departmental mission; and if the metallurgical labs of the Department of Energy, Mines and Resources are unrelated to its mission, perhaps we should not have them at all. There is no virtue just to have labs for the sake of doing research work.

The Chairman: That is why we recommended that some of those labs should at least be partially financed by industry; and if industry is not willing to put money into their research programs, it means that those labs are not very useful.

Hon. Mr. Drury: This is the policy of the National Research Council, which does not have a specific departmental mission to accomplish. This is in the natural

sciences. It is what I call reverse contract research. The industry contributes to the operation of the labs by means of a contract to do specific things, which is the reverse of the National Research Council entering into a contract with an industrial concern to do research for which it pays.

There is some of this reverse contract research, if I can use this phrase, even in departmental laboratories. The Department of Agriculture does some, a limited amount of, contract research, in its laboratory in Saskatoon, for instance. The Department of Energy, Mines and Resources does some reverse contract research—not very much, but some. Desulphurization of coal is one example, where the government department is paid for the work it does on behalf of industry.

Basically you are suggesting here that it might be useful if someone were to make a survey of all departmental laboratories and make sure that all of their work was directly and continuously related to the mission of the department. The question you raised about the forest products laboratory gives rise to a difficulty, in that we no longer have in the federal government a Department of Forestry, and responsibility for forest technology, having no department to put it in, is currently an activity . . .

The Chairman: I am not thinking about the research in forestry, but the research in forest products, which is supposed to serve manufacturing industries. There is a difference between research in forestry and research in forest products.

Hon. Mr. Drury: Yes; I can see that. I will undertake to inform myself a little better than I am on that particular point.

The Chairman: The brief states that NRC will be encouraged to make a significant shift in emphasis towards support of Canadian industry and contribution to the solution of specifically Canadian problems. Will NRC be encouraged to make this significant shift?

Hon. Mr. Drury: The National Research Council has in existence an industrial research assistance program. This has been growing modestly.

The Chairman: But these are grants.

Hon. Mr. Drury: They are both grants, contracts, and, in a number of instances, just straight uncharged advice. It is a combination of all three. They do, as a matter of policy, try to concentrate their activities in the rather smaller high technology industries, and the larger corporations are left to the care of the various industrial research assistance policies of the Department of Industry, Trade and Commerce. This is how the line tends to get divided.

The Chairman: But this is really not what you meant, I would presume, when you said that NRC would really be given a new role and would have to shift its operations and its programs so as to serve industry more directly.

Hon. Mr. Drury: Let me read the words, Mr. Chairman. "New role" is importing a bit.

The Chairman: Well, to make a significant shift.

Hon. Mr. Drury: Internal shift in emphasis.

The Chairman: Yes.

Hon. Mr. Drury: Changing emphasis isn't changing the role. I do not want you to have me saying that I was

offering or promising things which we were not. I am not in this brief proposing we are going to reform the whole world.

The Chairman: I thought you were just proposing to reform the NRC.

Hon. Mr. Drury: Rather more on the basis of a changing of emphasis than of saying, "What we have had in the past is no good at all, a complete failure. We have got to revise it from the ground up" that is a view I do not share. I think the National Research Council has been an extraordinary success, in terms of achievement and in adaptability. It has managed to evolve successfully, I think, in keeping pace with meeting our needs. What is required from time to time is a change in emphasis rather than a change in role.

The Chairman: Have they not defined a new role?

Hon. Mr. Drury: There has been a redefinition but it is rather more a redefinition of role than a brand new role. This redefinition has been made necessary by the plan to separate from the National Research Council the granting function in relation to basic research, fundamental research in the natural sciences and the creation of legislation for a new granting council, as a result of which, the National Research Council will have as its mission the operation of its laboratories and the charge of management of the industrial research assistance program.

Senator Grosart: The statement made in the redefinition by the NRC is that it will "encourage and assist, where feasible, R&D projects to be carried out in industry." It seems to me the government is urging NRC to transfer R&D to industry; NRC is encouraging the government to do so, the Science Council is encouraging both of them, and all three are encouraging industry to do it—but nobody is doing it. Everybody is telling everyone else they should be doing it.

Hon. Mr. Drury: Why?

Senator Grosart: I don't know. It is not happening. The figures show us it is not happening. Everybody says it should.

Hon. Mr. Drury: You are quite correct. It has certainly not been happening to the extent that we want it to. The National Research Council can point to some particular, almost spectacular successes.

Senator Grosart: I agree with that. We spent a whole day, Mr. Minister, in our previous examination complimenting the NRC on the specific cases they presented. We have no question that good things have been done in the NRC. That is not the point.

Hon. Mr. Drury: The point is you say you want more "Give me more!"

Senator Grosart: I want more R&D done in industry because the essential problem . . .

Hon. Mr. Drury: Just more. You admitted they are doing it.

Senator Grosart: They are doing it in their own place because the evidence all over the world is that the great problem is the transfer of the results of the R&D into industry.

Hon. Mr. Drury: Is the Bobtex the wrong place?

Senator Grosart: There have been successes, yes.

Hon. Mr. Drury: Is Leigh Instruments the wrong place?

Senator Grosart: I am not saying there are none. I am saying the overall result is that the funding in the industry is declining. You cannot get away from that.

Hon. Mr. Drury: I agree with that.

Senator Grosart: Yes.

Hon. Mr. Drury: Wholeheartedly.

Senator Grosart: We have had some success without any funding—Bombadier, originally.

Hon. Mr. Drury: I am suggesting in respect of this that the NRC has been headed in the right direction. They have not been going fast enough.

Senator Grosart: Good. I agree.

Hon. Mr. Drury: This does not call for a change in direction.

The Chairman: It may in a sense because, again, it has been proven time after time that R&D technology transfers from the supply side do not work.

I have a statement of John Diebold, who is a great expert in this field, who says:

Experience at technology transfer with the inventor or supplier pushing his wares and "finding applications" for predeveloped solutions has not worked really well in the United States.

We have the same problem here. We have our researchers doing research, supposedly for industry, but they choose their own programs and their own projects as they see fit, and then the transfer of knowledge does not happen. We are not exceptions in Canada. It has been proven all over the world. We still expect, in spite of all these experiences around the world, that it will work in Canada. It will not until we design our projects and our programs and plan them in greater co-operation with industry, in greater co-operation with the demand side where the need is rather than the supply side.

Hon. Mr. Drury: With this theory, I am in complete agreement. The various laboratories, in the case of the National Research Council, do this and say they are doing it.

The Chairman: They say they are doing it?

Hon. Mr. Drury: Yes. They produced a number of instances to you where this is being done. I did not hear the recital where they pointed out to you some failures. It does not work every time but because it does not work, because it is not a success, it does not mean that they are not trying. Our task really is to try and conclude what are the reasons for failure and make changes in that respect and modify what we are doing and not repeat failures.

The Chairman: I have read the last annual report by the president of the NRC where he defines the redefined role of the NRC. It is stated:

The following activities will form the basis of NRC's future research program:

- i) basic and exploratory research;
- ii) long-term research—;

- iii) industrially-oriented research and research services to industry;

- iv) research to provide technological support of social objectives;

- v) specialized major research facilities developed and operated as national facilities;

- vi) physical measurements and standards.

Dr. Schneider goes on to say that one quarter to one-third of NRC operations will be devoted to basic and exploratory research.

I have compared the above future program with a list prepared by Dr. Steacie for NRC back in 1958. Dr. Steacie then said:

As far as the National Research Council is concerned, the list includes fundamental work, long-term applied work with no specific objective, work on specific industrial problems, short-term industrial problems (i.e., ad hoc investigations), investigations for the services, consulting, testing, specifications and miscellaneous inquiries.

I find that the list produced by Dr. Schneider in 1974 is remarkably similar to the list presented by Dr. Steacie in 1958. I fail to see a significant difference.

Hon. Mr. Drury: I think that was the point I was making to Senator Godfrey; this is not a new, hitherto unthought of role.

The Chairman: There is nothing new.

Hon. Mr. Drury: It is a redefinition.

The Chairman: It is a new definition of an old definition.

Hon. Mr. Drury: If you charge me with that, I say, yes, you are correct. I am in agreement with you that what has taken place is really a re-affirmation of the non-university granting role, which they have been performing.

The Chairman: I prefer that.

Hon. Mr. Drury: Not a brand new role. If anyone has ideas as to what role they should be assuming in a more satisfactory manner, and it is one in which they have been successful, perhaps not as much as everyone would like, all right. They still have been an extraordinary successful government operation over the years.

The Chairman: I do not question that. I was trying to relate to this redefined role, the statement which is made in your brief that a significant shift in emphasis towards the support of industry would be made in NRC, which implied, at least to me, new priorities so far as their programs and projects of R&D are concerned. And I do not see that reflected in this redefined role.

Hon. Mr. Drury: I feel that what really would be hoped for is that over a period of time as the NRC grows, and one would expect it to grow along with the country, that the growth would be external under the "make or buy" rather than internal. And to the extent that capacity for handling research can be developed within Canadian industry, then NRC will be glad to turn over these functions to industry, to spin them off. A case in point, on a fairly large scale, was nuclear research, particularly in the field of atomic fission, which started out in NRC. It was an in-house

operation and they spun it off to a crown corporation initially called Atomic Energy of Canada Limited, and divorced themselves entirely from this program except on an interchange basis. The program and that particular field was turned over to Atomic Energy of Canada. Atomic Energy of Canada has consistently, and at some considerable expense to the taxpayer, endeavoured to spin off to Canadian manufacturing industry a number of its functions. But they have not been successful.

The Chairman: Up to the point when they were told that Ontario Hydro was not prepared to deal with a private monopoly, as you remember quite well. Then they stopped the spin off.

Hon. Mr. Drury: As I say, they have not been successful in spinning off and doing what is sought here, but it was not for want of trying.

The Chairman: They were told by Ontario Hydro they would not tolerate that.

Hon. Mr. Drury: Well, I suppose one could stand up and show Ontario Hydro who is boss, but it so happens that Ontario Hydro is one of the largest clients.

Senator Lang: It was.

Senator Carter: How can AECL spin off to private industry if private industry does not have the capacity to take it over? That is what we are complaining about. Government does not seem to be encouraging industry to build up the capacity.

Hon. Mr. Drury: Well, the committee might be interested in this particular case history, the efforts that were made and why they were not successful. At AECL's expense there was an investment made in two organizations. One was Canadian General Electric...

The Chairman: We know the history very well.

Hon. Mr. Drury:—and CanAtom. You say there is no capacity and that the government is doing nothing about it. That is just incorrect. That is uninformed.

Senator Carter: Well, we are doing less and less about it.

Hon. Mr. Drury: Senator, please don't make statements like that. They just do not happen to be true.

Senator Carter: This is what the figures are showing.

Senator Godfrey: You cannot jam things down people's throats if industry is not prepared to accept it and if industry is not taking up the offers that are being made. That is what I understand the evidence to be so far.

The Chairman: I think the minister's illustration might not be too well chosen. We know the story very well. We were told at that time that General Electric had developed a capacity and AECL was trying to contract out as much business as it could to them, but then they were told by Ontario Hydro that Ontario Hydro would never deal with a private monopoly. So this contracting out business had to be stopped any they had to reintegrate the whole research and development operation into AECL, so it was not the failure of industry or of AECL, but it was the policy of Ontario Hydro who, as the minister said, was the main client.

Senator Godfrey: Did we come up with a better solution as to what should have been done?

The Chairman: The team in General Electric had to be transferred to AECL, which was the reverse of contracting out.

Senator Godfrey: Well, I do not think the department can be blamed for that particular episode as you have described it.

The Chairman: But industry cannot either.

Senator Godfrey: Industry would be foolish, simply because there was a lot of money there, to go out and spend it if they do not have something good to spend it on. So the fact that money is not being spent does not necessarily mean that it is a failure. If they were to take it out to ram it down their throats so as to get better figures, that would not make the situation any better.

Senator Rowe: This spin-off process, is that done by the NRC as part of government policy, or does NRC have inherent powers to take action on its own? What is the exact process? Does the government go to NRC and say, "We think you should divest yourself of this particular function or responsibility," or does the NRC say to government, "We think we should do this" and then say to the appropriate government department, "We would like to do this with respect to this organization in private industry"? What actually happens?

Hon. Mr. Drury: Generally it is the latter. I think that the president has probably told you that.

The Chairman: He has not been before us yet.

Hon. Mr. Drury: Well, he will be. He believes in this spin-off policy because he believes that the role of the National Research Council is germination rather than operation and exploitation. Their job is to initiate ideas, techniques and processes and then find somebody to make use of them. They are doing this all the time. A rather more recent example I might cite is this; the chemical laboratory discovered a technique utilizing the principle of surface tension for the separation of oil and sand and clay through englobulation without any heat being required at all, and this in energy terms is likely to be a very much more economical process in dealing with the large volumes of petroleum, sand and clay all mixed together in the tar sands. Having developed this technique in the laboratories and having run a laboratory test to prove it out, they then set about and succeeded in finding a group in Calgary who will take this over now, and with assistance, both technical and financial, from the National Research Council, will bring this to the commercial exploitation stage. Hopefully, the industrial sector will be making use of this new technique, exploiting this discovery for more efficient extraction of petroleum from the tar sands. But this is what they are about all the time. This is the way they go about it.

The process of finding somebody who wants to exploit and who is likely to be able to successfully, is quite hard in Canada. We have not too many of these fellows.

The Chairman: It is hard all over the world, apparently. It did not work in the United States either.

Hon. Mr. Drury: This particular company's basic *raison d'être* comes entirely from the National Research Council. I mentioned the Bobtex process. Perhaps it should have been, but here it was not a case of industry coming to the National Research Council and saying, "Find us a way of

doing this separation more efficiently." The idea or the perception of the need for this arose in the laboratory of the National Research Council. It was a case of setting to work on a response to an immediate and very practical need. This has been a good juxtaposition. It is not the sort of thing which can be labelled esoteric research of no practical value to anybody at all, but it is on a very small scale.

The nuclear project of which I made mention is one right at the other end of the spectrum. But the proposal to establish a separate crown corporation with a view eventually of spinning off to the private sector, that proposal emanated from the National Research Council. It was not the government telling the National Research Council, "This is what you fellows should be doing."

So in the two instances I have cited, the initiative to spin off came from the Council.

The Chairman: Well, we will have another occasion to ask questions of the President of NRC so, if you don't mind, perhaps we could proceed to another section of the brief.

Hon. Mr. Drury: Just for the sake of the record, Mr. Chairman, may I give you some figures here? In relation to the National Research Council they talk about shifting emphasis. In relation to the whole of the extramural expenditures by the National Research Council, the proportion of that going to industrial contracts and contractors has risen from 19 per cent in 1973-74 to 25 per cent in 1975-76. Well, that is not a revolution but it indicates the direction in which the National Research Council is going to proceed. Here they are achieving some measure of success.

The Chairman: So that eventually if they all contract out their industrial research programs, they will become an academy for pure and basic research, which is what we recommended.

Hon. Mr. Drury: Yes.

Senator Bourget: Don't say "yes" too fast.

Hon. Mr. Drury: That, I think, is the theory. Still, because of the tremendous size of Canada, our relative lack of density in the industrial sense means that the National Research Council will have to do laboratory work in applied science for some time to come.

Perhaps I might just cite the wind tunnel as a case in point. The National Research Council built and operates and controls a wind tunnel not because it wants to do it itself, not letting private industry do it, but because, given the relatively small size of the users and their separation across Canada, the NRC is the best vehicle for doing it.

The Chairman: Are they making a profit or meeting their costs?

Hon. Mr. Drury: Sometimes they meet their costs; sometimes they do not. The direction they have is to recover their costs. But, unfortunately, it is one thing to order them first to establish the tunnel, about which they had no discretion at all, and then another to tell them to recover the cost, if they cannot be fortunate enough to find enough users in any given year.

Senator Rowe: I presume they were ordered by the federal government to establish the wind tunnel. Is that right?

Hon. Mr. Drury: They were ordered to by the government, yes.

Senator Rowe: Could they have gone ahead on their own and established that wind tunnel without having an order or some instruction from the government?

Hon. Mr. Drury: In respect of large capital expenditures, the National Research Council is a crown corporation and it has its budget reviewed annually by the government. I do not think the government would say, even to the National Research Council, "We will give you an unlimited sum of money to do whatever you want with it."

Senator Lang: Was the low-speed wind tunnel required of NRC by the government?

Hon. Mr. Drury: That is the old one. It was much less costly, as you know. It is a relatively small tunnel in a laboratory on Montreal Road. It was an experimental tool sought and asked for by the National Research Council. It was for the benefit of the researchers at NRC rather than for the benefit of the aeronautical industry in Canada. On the other hand, the big wind tunnel at Uplands was really constructed at the request of and for the benefit of the aeronautical industry in Canada.

Senator Lang: I hope De Havilland and Canadair can use it now.

Hon. Mr. Drury: You mean you hope that they will have occasion to use it. Yes, I think we all share that hope.

The Chairman: You may not be able to answer this question in an exact way, but when can we expect the new legislation respecting the granting councils to come before Parliament?

Hon. Mr. Drury: I will have to consult the house leader on that.

The Chairman: The legislation is ready?

Hon. Mr. Drury: The legislation is all ready. It is just a question of finding a place in the parliamentary timetable.

The Chairman: You are not too sure if it will be during this or the next session?

Hon. Mr. Drury: Let me put it this way: I would be more sure that it will be in the next session than I would be that it would be in this session—but when I say "session," perhaps I had better not talk about a session.

Senator Lang: Before the end of June?

Senator Manning: Of which year?

Hon. Mr. Drury: We have in the House of Commons a crowded bill of fare to get through before June 30 as it is, as I think you are perhaps well aware. There does not appear to be as much opportunity to deal with this legislation during that period as there will be subsequent to June 30.

Senator Lang: You would prefer us to introduce it in the Senate, Mr. Minister, to expedite the procedure?

The Chairman: It is a money bill.

Hon. Mr. Drury: It is a peculiar money bill. All it does is give money away.

The Chairman: Can we spend a few minutes on technology assessment now, which is the last subsection of

section (c)? This is on page 19. How many experts work on technology assessment in the ministry?

Hon. Mr. Drury: Il y en a trois, monsieur le président.

The Chairman: And then what is the composition of this project management committee?

Hon. Mr. Drury: Perhaps I had better let Dr. LeClair either answer directly or get one of his resource men to do so.

Dr. LeClair: Mr. Chairman, you ask what is the composition of the project management committee. This committee is chaired by myself, and the four assistant secretaries are members of it, plus one or two directors general, within their own branches. Its purpose is to look at all the projects that MOSST undertakes to study, and allocate the resources and the man-years or man-months or man-days that are necessary for it, using, as far as we can, the matrix system; that is, making use of people from different branches to undertake these projects.

The Chairman: I presume that there are quite a number of government agencies doing technology assessment work. Your ministry does, for one, and Health and Welfare, in its own field, must do something, as must Environment and Consumer Affairs. How is this work being coordinated at the moment?

Dr. LeClair: Mr. Chairman, I think we would have to make sure here of what we are talking about. Are you talking about technology assessment in a narrow sense, or are you talking about future studies in a general sense?

The Chairman: Is this technology forecasting that you are doing, or assessment?

Dr. LeClair: It is both, really. Formerly this division had both the name of technology forecasting and assessment, and there is a fine line between the two which is hard to differentiate. As you know, there is at the moment a major effort being made to coordinate the future studies being done by various departments.

The Chairman: In this kind of work, have you been trying to establish contact and relations with the United States Congress? As you know, they have established quite an operation down there, and they have a technology assessment agency under the directorship of ex-Congressman Daddario which is supposed to be doing the best work in this area in the world. It is a very complex area. Have you any contact with what is going on down there?

Dr. LeClair: Yes. I met Mr. Daddario myself about eight months ago, and Dr. Maybloom visited him last week. He is in contact with our staff, so we know what they are doing. Very much so.

Senator Carter: I would like to ask what is MOSST's role in assessing the effects of technology, such as the Port Hope radiation situation, the mercury poisoning of Indians, and the problem with the reactor south of the border. What role does MOSST play in assessing these effects?

Dr. LeClair: To be specific about the examples you have mentioned, the answer is, none. We have no role. This is being done by line departments such as, in this particular case, Environment and Health and Welfare, and so forth, who have the capability and the laboratories to enable them to do whatever is necessary there. The role of MOSST is not necessarily to do those specific studies. The role of

MOSST is to make sure that there is a mechanism in government capable of doing these things whenever the necessity arises. In this particular case that mechanism is in existence and it is being used.

Senator Carter: Is anybody engaged in forecasting the possible effects of technology? For example, we thought at one time that DDT was a great blessing until we found that it had side effects that were rather dangerous. There are all sorts of compounds coming out at present, and all sorts of technology being developed. Is anybody in MOSST assessing the possible effects of these? Are you monitoring what is going on in other countries?

Dr. LeClair: No, Mr. Chairman. Specifically, the answer again is no. We are making sure that government departments are doing this, and in fact they are. I can give you examples of this. Recently there was the freon problem. MOSST has made sure that some other department is looking after this. In this particular case it was Environment. MOSST, however, does not have the capability, and perhaps it should not have the capability to do this, because it would be perhaps a duplication of what is happening in other departments.

Senator Carter: You say MOSST leaves it to the department involved. What about trans-border incidents? Are they left to the individual departments as well?

Dr. LeClair: Your question is very general and I will have to give a general answer. By "trans-border" you mean incidents as between the United States and Canada?

Senator Carter: Yes.

Dr. LeClair: There are agencies looking at some of these situations; for example, the Great Lakes; again, however, we would deal through External Affairs, and make sure that if there are problems of this kind they are dealt with appropriately. Again, however, MOSST would not be involved directly in these studies.

The Chairman: In your study on energy technology you mention that this was done in collaboration with other agencies, but I do not see here the names of AECL or NRC.

Dr. LeClair: You are talking about which one?

The Chairman: Well, when you studied the fusion system, and so on . . .

Dr. LeClair: I think there were four original partners to the fusion study. It is somewhere in the brief. Yes, it is right here. The four were MOSST, the Atomic Energy Control Board, Supply and Services, and National Defence.

The Chairman: But AECL and NRC are not there. I was rather surprised to see that.

Dr. LeClair: I cannot tell you why they were not there, because that study was started before I came to MOSST, but they were certainly among the departmental people who looked at the report, and as a case in point, at this time, the leading partner for fusion is NRC.

The Chairman: Are there any more questions on this? I have just a couple of others, if members of the committee do not have any. They are not on this point, but on more general issues.

Senator Manning: Mr. Chairman, there is a reference in the brief to the comprehensive assessment by MOSST of solar energy systems for Canada. I understand that quite

recently a very large research project has been approved in the United States in this area. I believe it is in Arizona. Would MOSST have a liaison with a development of that kind in the United States?

Dr. LeClair: Not necessarily, Mr. Chairman. The Department of Energy, Mines and Resources would be the department that normally would have access to this kind of information, and would have exchanges on a regular basis with these people.

Senator Manning: Would it be a matter of government policy to pursue a thing of that kind?

Dr. LeClair: Definitely; no doubt about that.

Senator Lang: Would that apply to thermal energy, too?

Dr. LeClair: I do not know about the particular case you are talking about.

Hon. Mr. Drury: Do you mean geo-thermal energy?

Senator Lang: Yes.

Dr. LeClair: I am sorry, I thought you were talking about the other one.

The Chairman: We have recommended in our report that Lord Rothschild's proposal to organize research programs within departments and agencies on the customer-contractor basis be considered. I understand that this program developed by Lord Rothschild has been accepted in Great Britain. I also understand that it has meant a great improvement in the decision-making process of individual departments and agencies. I have seen no comment in the brief with respect to this recommendation. I wonder if you have given any thought to suggesting to the government or various departments and agencies that they try this formula.

Dr. LeClair: Mr. Chairman, I have recently studied what has happened in the U.K. with respect to this Rothschild recommendation. As you know, approximately 16 per cent of the funds that the Research Council had were transferred to the departments, the major-sized of which were each given a chief scientist from the outside. However, up to now, meaning a few months ago, the departments returned to the Research Council most of that money in the form of contracts. I was told by the chief scientist that that was the last year. So, in fact, we can not yet assess what has happened in Great Britain. The machinery is there but they have not used it. There is another form of machinery, known as the Procurement Board, which they have used very well. In other words, the money for contracts of a given department is decided by a Procurement Board, chaired by someone from industry, with representation from both industry and government, which actually spend the money of the department.

The Chairman: This is really what I mean; I did not mean any transfer of money from the research councils.

Dr. LeClair: With respect to that part of it, from what we can gather in talking to both government and industrial people, there has been great enthusiasm about this, but it has not been going on for a long time.

The Chairman: No, but is there any thought of applying such a system here?

Dr. LeClair: Mr. Chairman, that is policy.

Hon. Mr. Drury: You say, is there any thought?

The Chairman: You were thinking.

Hon. Mr. Drury: We have not reached a conclusion with respect to this and I would hesitate, quite frankly, to argue pro or con, one way or the other in this regard. In a sense, the essential difference, really, is that the advice as to how and what is being procured, is made by a joint group, rather than purely by the departmental or the government officials.

The Chairman: There is a kind of arm's-length negotiation there?

Hon. Mr. Drury: Yes. They have one advantage in the United Kingdom which we do not have, that is that in most areas there are a number of potential performers. In the case of Canada, in many instances there is only one possible performer and whether he is on a committee deciding the terms of the contract that he is going to get or not might give rise to some question of conflict of interest.

The Chairman: This principle is applied, to a certain extent, to contracting out, as well as to the development and research of intramural programs and projects. Throughout our meeting, Mr. Minister, you have insisted that the individual departments and agencies should be the main decision-makers in these areas. I agree with that, but I also feel that it is the responsibility of the government to see that these departments and agencies are equipped to apply the best decision-making process possible in order to define, in the most realistic and effective terms, their own research programs.

Hon. Mr. Drury: I agree with that in principle, Mr. Chairman, but I am not too clear as to how this might be applied to the quite substantial research effort on the part of the Department of Agriculture.

The Chairman: Perhaps we might look into that. It might reduce that effort if there were some kind of negotiation instead of the individual departments, as they do now, accepting or turning down projects which come from their own researchers. In any event, I suppose you will look into that.

Hon. Mr. Drury: In a sense, this was the successful experience of the Defence Research Board. The board itself was a mixed body and one which authorized projects, both external and internal. Unfortunately, there were frequent conflict-of-interest situations arising. I hope to give you a better rationale for acceptance, or otherwise, of this at a later date.

The Chairman: One last question. I have recently become aware that it is now estimated that total R&D expenditures in the United States, both private and public, in 1976 will reach \$38.1 billion, an increase of 11.1 per cent over expenditures in 1975, which indicates a resumption of the trend prevailing in the United States prior to 1968. Those are expenditures in current dollars. Do we have such estimates in Canada; and, if so, how do we compare with the United States in that regard?

Hon. Mr. Drury: We do not have any forecast expenditures for the private sector, Mr. Chairman. Unfortunately, the survey of investment intentions, which is carried on by Industry, Trade and Commerce, does not break out science-related expenditures or research and development.

The Chairman: It would not cover current expenditures, in any event.

Hon. Mr. Drury: One would get the current figures from Statistics Canada.

The Chairman: But I am referring to the figures on R&D. The Department of Industry, Trade and Commerce survey on investment intentions only covers capital expenditures, not R&D expenditures.

Hon. Mr. Drury: Yes. Mr. Chairman, I understand there was some confusion at an earlier meeting about a program of the Department of Industry, Trade and Commerce called the University Grant Program. There was an indication that \$1 million had been set aside for this. An impression may have been left in the minds of the committee that this was anticipated at the rate of \$1 million per annum.

The Chairman: That is not what they say.

Hon. Mr. Drury: In fact, they have had for some years a program to undertake research on the innovative process. That has been running at the rate of something just in excess of \$200,000 a year. It is quite true that over the five-year period it would amount to \$1 million. It is not at the rate of \$1 million a year.

The Chairman: I do not think I indicated that. I knew it was on the basis of the last five years that we reached the amount of approximately \$1 million.

Hon. Mr. Drury: This is not a new program. I think you have some considerable detail on the results of this program.

The Chairman: The only reason I raised this in your absence is because I wanted to know if MOSST was aware of these studies and had access to them. We certainly do not.

Hon. Mr. Drury: The answer is that we are aware of this program and have been making use of the output of the product.

The Chairman: Thank you, Mr. Minister, on behalf of the committee. I hope that when we reach the last phase of our hearings, we will have the privilege of calling you back for a summing up.

Hon. Mr. Drury: I am not sure whether you should be looking to me for the summing up of your work.

The Chairman: No, no; but we may develop some residual questions as a result of our more detailed examination of individual departments and agencies.

The committee adjourned.

APPENDIX "16"

TOTAL FEDERAL EXPENDITURES ON SCIENTIFIC
ACTIVITIES BY PERFORMERS,

1970-71—1976-77

In percentages

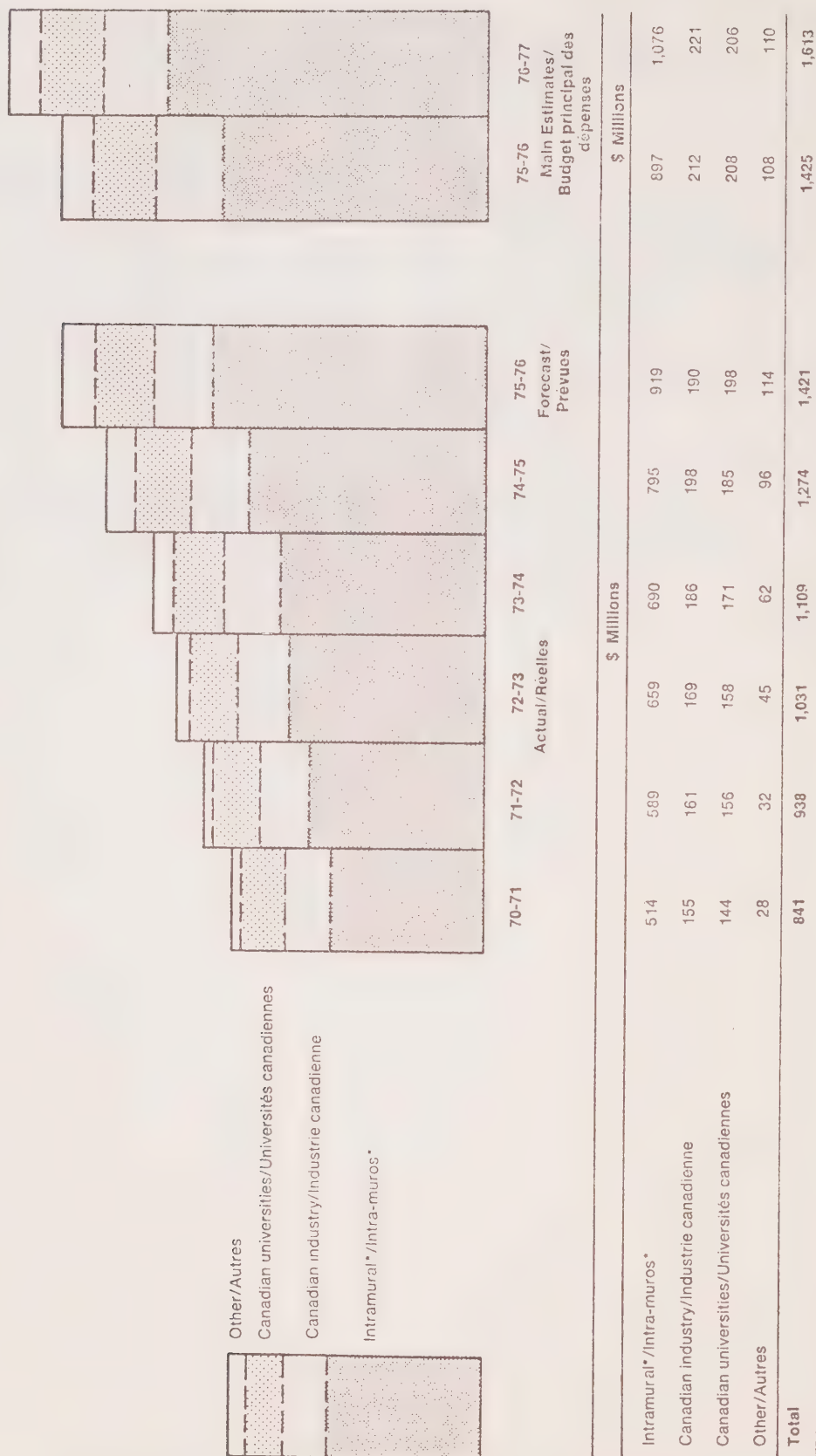
						(1)	(2)
	1970-71	1971-72	1972-73	1973-74	1974-75	1975-76	1976-77
Intramural	61.1	62.8	63.9	62.2	62.5	64.7	66.7
Canadian Industry	18.4	17.2	16.4	16.8	15.5	13.4	13.7
Canadian Universities	17.2	16.6	15.3	15.4	14.5	13.9	12.8
Others	3.3	3.4	4.4	5.6	7.5	8.0	6.8
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: *How Your Tax Dollar is Spent*, 76/77

(1) Forecast

(2) Main Estimates

APPENDIX "17"



*Federal government establishments

* Au sein du gouvernement fédéral

Note: Differences from previously reported figures arise from an on-going revision process at Statistics Canada intended to improve the accuracy of the historical series, and from modification of this year's Main Estimates Science Survey to provide a more complete coverage of expenditures on science.

Note: Les différences par rapport aux données déjà publiées résultent d'une part du processus continu de révision par Statistique Canada, afin d'améliorer la précision des séries chronologiques, et d'autre part de la modification de l'enquête sur les sciences pour le Budget principal des dépenses afin de fournir plus de détails sur les dépenses dans le domaine scientifique.



FIRST SESSION—THIRTIETH PARLIAMENT
1974-76

Government
Publications

THE SENATE OF CANADA
PROCEEDINGS OF THE
SPECIAL COMMITTEE OF THE SENATE ON
SCIENCE POLICY

The Honourable MAURICE LAMONTAGNE, P.C., *Chairman*

Issue No. 6

WEDNESDAY, MARCH 17, 1976

Sixth Proceedings on:

“The Study of Canadian Government and other
expenditures on scientific activities
and matters related thereto.”



(Witnesses and appendices: See Minutes of Proceedings)

THE SPECIAL COMMITTEE OF THE
SENATE ON SCIENCE POLICY

The Honourable Maurice Lamontagne, P.C., *Chairman*

The Honourable Donald Cameron, *Deputy Chairman*

and

The Honourable Senators:

Asselin	Hastings
Bélisle	Hicks
Bell	Lang
Blois	Manning
Bonnell	Neiman
Bourget	Riel
Buckwold	Robichaud
Carter	Rowe
Giguère	Stanbury
Godfrey	Thompson
Goldenberg	van Roggen
Grosart	Yuzyk
Haig	

27 Members

(Quorum 5)

Order of Reference

Extract from the First Report of the Special Committee of the Senate on Science Policy, presented on July 10, 1975 and printed as an Appendix to the Minutes of the Proceedings of the Senate of that day, and adopted by the Senate on July 24, 1975:

"The Committee, therefore, recommends that it be authorized to consider and report on Canadian government and other expenditures on scientific activities and matters related thereto;

That the Committee have power to engage the services of such counsel and clerical personnel as may be necessary for the purpose of the inquiry;

That the Committee have power to send for persons, papers and records, to sit during adjournments of the Senate and to report from time to time; and

That the Committee be authorized to print such papers and evidence from day to day as may be ordered by the Committee."

Robert Fortier,
Clerk of the Senate.

Minutes of Proceedings

Wednesday, March 17, 1976

(15)

Pursuant to adjournment and notice the Special Committee of the Senate on Science Policy met this day at 4:10 p.m., the Chairman, the Honourable Senator Lamontagne, presiding.

Present: The Honourable Senators Bonnell, Bourget, Carter, Giguère, Godfrey, Grosart, Lamontagne, Lang, Neiman, Robichaud and Yuzyk. (11)

In attendance: Messrs. Philip J. Pocock, Director of Research and Jacques W. Ostiguy, Chief of Administration.

The Committee proceeded to the consideration of its Order of Reference dated July 24, 1975 relating to the study of Canadian Government and other expenditures on scientific activities and matters related thereto.

During the course of the Chairman's introductory remarks it was *Agreed* that the brief presented to the Committee by the Department of Industry, Trade and Commerce be printed as an appendix to this day's Minutes of Proceedings and Evidence. (*See Appendix No. "18".*)

The following witnesses from the Department of Industry, Trade and Commerce were heard:

Mr. Lubor F. Drahotsky
Assistant Deputy Minister
Industrial Policies

Dr. Sydney Wagner
General Director
Office of Science and Technology

Mr. Drahotsky made an opening statement. The witnesses then answered questions put to them by members of the Committee.

At 5:40 p.m. the Committee adjourned to the call of the Chairman.

ATTEST:

Patrick J. Savoie,
Clerk of the Committee.

The Special Committee of the Senate on Science Policy

Evidence

Ottawa, Wednesday, March 17, 1976

The Special Committee of the Senate on Science Policy met this day at 4.10 p.m. to consider Canadian government and other expenditures on scientific activities and matters relating thereto.

Senator Maurice Lamontagne (*Chairman*) in the Chair.

The Chairman: Honourable senators, as you know, we are discussing today the brief submitted to us by the Department of Industry, Trade and Commerce. At this stage I should like to propose that in accordance with our usual practice the brief be printed as an appendix to today's proceedings. Is it agreed, honourable senators?

Hon. Senators: Agreed.

(*For text of brief see Appendix No. "18" page 14.*)

The Chairman: We have with us, representing the department today, Mr. Lubor F. Drahotsky, Assistant Deputy Minister, Industrial Policies, and Dr. Sydney Wagner, General Director, Office of Science and Technology.

I suggest that we start today with general questions not directly related to any specific part of the brief, after which we could try to cover, if there is time, sections A and B of the brief, leaving sections C, D and E for another meeting if there is not sufficient time to deal with them this afternoon. I hope that arrangement is satisfactory to honourable senators.

Hon. Senators: Agreed.

The Chairman: Before we begin to ask questions, I understand that Mr. Drahotsky would like to make a brief statement.

Mr. Lubor F. Drahotsky, Assistant Deputy Minister, Industrial Policies, Department of Industry, Trade and Commerce: Thank you, Mr. Chairman. Honourable senators, my colleagues and I, personally, very much welcome the opportunity to appear before you on behalf of the department in order to bring you up to date on our activities.

Before I proceed with my introductory statement, I should like to introduce the other members of our team who are here this afternoon. If I may, I will take them in the order in which they are seated, starting with Mr. W. Graham, who is Assistant Director of the Programs Office. Next to him is Mr. D. Boxall, who is Chief of the Programs Branch in the Office of Science and Technology. Next to him is Mr. H. C. Douglas, Director of the Programs Branch in the same office. Next to him is Mr. J. B. Wickes, Director of the Technology Strategy and Forecasting Branch in the Office of Science and Technology, and, finally, Mr. R. A. Reynolds, who is the Science Adviser in the Office of

Science and Technology. So we have with us a fair cross-section of the people who are involved in the questions of science and technology in the department.

Mr. Chairman, I understand that during these hearings your committee would like to focus on three areas. First of all, I take it you are interested in a survey of activities relating to future studies. Secondly, I understand you would like to update the information base which your committee developed during its 1968-69 hearings. Lastly, I understand you would like to review the responses which have been made by government departments and other agencies in response to your recommendations which you made in the various reports published in 1972-73. I understand you have made some 73 individual recommendations bearing on various aspects of innovative activity.

With respect to the future studies, I believe, Mr. Chairman, you have received to reply to your questionnaire of last October. We have tried, to the best of our ability, to deal with questions 1 to 19 on the understanding that Mr. Drury would respond to questions 20 to 26 on behalf of the government as a whole.

With respect to the information base, you have before you our report, which is designed to update the information which we placed before you during your first hearings. Now, the submission in a way responds to some of the recommendations which you have made, but looking at it again I realize that perhaps we have not adequately set out in this submission the relationship between the various initiatives which I have described in it and the recommendations which your committee made and which, in one way or another, gave rise to the initiatives which are covered in our submission.

I should like, therefore, to focus on that particular aspect in my opening remarks. There are, in all, some eight policy initiatives which I should like to focus on and with respect to which I should like to outline how, in our view, they relate to your committee's recommendations.

First of all, Mr. Chairman, in your report you expressed concern that little had been done in Canada to study the practices and results of innovative strategies, and you went on to recommend that schools of management should be the main centres of research on the complex problems of R&D management and innovation strategies. The department shared these views and, in response to your recommendations, instituted a program of grants to the university faculties of commerce, economics and business administration so that they could study the process of and impediments to technological innovation and the question of management of innovation in the Canadian environment.

Secondly, Mr. Chairman, in order to break down what I believe Senator Carter the other day described as "the three solitudes," and to encourage excellence in specific areas of technology, the department has introduced a pro-

gram of grants to universities, provincial research associations and industrial organizations for the establishment of centres of advanced technology and industrial research associations. Those programs are described in detail in the submission which is before you.

Senator Grosart: Those grants are to whom?

Mr. Drahotsky: They can be to a university, or to a provincial research council, or to an industrial organization, an organization representing a particular sector of the manufacturing economy.

Senator Grosart: But not to individual industries.

Mr. Drahotsky: Not to individual industries per se, unless the particular industry has developed an association, for example, to represent its collective interests.

To continue my enumeration, Mr. Chairman, the third point is that we have taken a number of steps to improve the impact of and access to our technology-oriented programs. For example, under the PAIT program the form of assistance has been changed from a conditional loan basis to a grant basis, and more recently the administration of the program has been decentralized. The responsibility for administration of projects up to a certain level has been delegated to committees chaired by our regional directors. Similarly, the Industrial Research and Development Incentives Act, or IRDIA, as we call it, and the regulations under the act, have been amended to remove certain anomalies, to clarify certain provisions and to speed up administration.

The Chairman: Is this a post mortem?

Mr. Drahotsky: No, Mr. Chairman. This was before the patient died.

Honourable senators, I have heard that the program that was supported under this program was terminated as of the end of last year as part of the efforts on the part of the government to reduce expenditures.

Finally, about a year ago the department initiated an in-depth review of all its support programs, including the technology programs. While it would be improper for me at this time to try to forecast the outcome, I think I am safe in saying that the recommendations that will eventually emerge will go a long way along the lines of your committee's recommendation that all existing specific grants designed to encourage RandD activities in industry be integrated into one multi-purpose program, to be administered by IT&C.

I should also note, in this context, that the projects previously supported by the Department of National Defence under its defence industrial research program, known as DIR, can now qualify for support under our programs. I believe the only remaining project-oriented industrial RandD grant program is the Industrial Research Assistance Program, known as IRAP, administered by the National Research Council.

With regard to the fourth policy initiative, Mr. Chairman, your committee expressed concern about the organizational arrangements in the new Department of Industry, Trade and Commerce, which was created at just about the time your investigation was getting under way.

The Chairman: In 1969.

Mr. Drahotsky: As you know, the department was created by the integration of what used to be the Department

of Trade and Commerce and the Department of Industry. Specifically, I believe, you were concerned about the balance between the trade and industrial missions in terms of resources and senior management time devoted to those missions. On that particular aspect, over the past five years the department has implemented a number of organizational changes designed to meet these concerns. For example, three years ago the responsibility for technology and innovation was put together with that for the other elements of industrial policy, and was identified as a senior level responsibility, separate from that for trade policy.

Recently, as a result of another realignment of organizational arrangements, responsibility for coordination, monitoring and evaluation of all departmental programs was vested in a senior assistant deputy minister for finance and programs. A senior policy committee, chaired by the deputy minister, was also established, to ensure balanced consideration of all issues. Lastly, to ensure proper coordination of all activities under his jurisdiction, the minister set up a trade and industry council composed of senior officers of the department, and all agencies reporting to him, which meets regularly under Mr. Jamieson's chairmanship.

I believe, Mr. Chairman, that these steps go a long way towards meeting the committee's concerns in this area, which obviously were quite legitimate at the time they were expressed.

I come now to the fifth policy initiative. Your committee made a number of recommendations in the area of industrial development policy. A year ago the department proposed, and cabinet approved, a more systematic approach to the development of industrial policies, which include:

(a) the development of sector strategies for principal segments of Canadian industry;

(b) the setting up of industry sector consultative committees to assist in the development and implementation of sector strategies; and

(c) the establishment of a senior interdepartmental committee on industrial policies and strategies to assist in the identification of industrial policy issues and the development of appropriate responses.

Consideration progress has been made in implementing the various elements of this new approach over the past year.

On a related issue, your committee, Mr. Chairman, recommended that the chairmanship of the interdepartmental committee on innovation be transferred from the Department of Industry, Trade and Commerce to MOSST, and that its scope, composition and authority be enlarged. The department concurred in this recommendation. The committee, previously chaired by IT&C, was supplanted by the interdepartmental committee on industrial technology policy, chaired by MOSST, and more recently by the interdepartmental committee on industrial policies and strategies, which I referred to earlier.

I believe, Mr. Chairman, that it is generally agreed that the creation of the federal Business Development Bank represents a good initial response to your recommendations respecting the Canadian Innovation Bank. I should add that the needs of small- and medium-sized businesses are under continuous review by the interdepartmental committee on small businesses, which was originally established to assist in the implementation of the federal Business Development Bank.

Lastly, Mr. Chairman, your committee recommended that IT&C and MOSST set up a "marriage bureau" to expedite partnership between Canadian and foreign firms. In relation to this recommendation, the department has established a centre for the promotion and marketing abroad of Canadian capability to participate in turnkey projects, or joint ventures, abroad. Its activities are described at the top of page 12 of our submission.

Mr. Chairman and honourable senators, in summary I hope you will agree that the department has lacked neither desire nor imagination in responding to the many valuable recommendations made as a result of your initial investigation.

I thank you very much for the opportunity to make this introductory statement. I and my colleagues are at your disposal to answer any questions that you may have.

The Chairman: Thank you very much, sir, for this progress report. I am sure that some, at least, of my colleagues will be satisfied with this initial statement showing that you have reacted positively to some of our recommendations. I am sure we will have more specific questions to ask as we go along on the various points that you have raised this afternoon.

For the honourable senators who were not here at the beginning, when I made my original statement, I proposed this afternoon—and time is going on, I can see—that we start by asking general questions not related to any specific part or section of the brief, and then perhaps try to cover sections A and B of the brief this afternoon, leaving the rest for consideration next week.

I would like to start with three very brief questions of my own, and then let my colleagues ask their own general questions.

In the course of preparing the estimates of the Department of Industry, Trade and Commerce, do you separate proposed expenditures to be devoted to scientific activities from other expenditures?

Mr. Drahotsky: In response to that question, Mr. Chairman, I would say that our departmental budget is structured in such a way as to separate clearly the expenditures on research and development, and innovation. These expenditures take the form of grants and contributions. There is a separate section, as you know, in the estimates, which defines the individual items under those two categories.

The Chairman: So that in fact you separate your proposed expenditures that relate to scientific activities?

Mr. Drahotsky: Yes, indeed. Our budget is so structured as to permit such a separation.

The Chairman: Then once these proposed expenditures have been separated from the rest of your budget or your main estimates, did you consult MOSST on your proposed scientific expenditures for 1976-77 before submitting them to Treasury Board for review and approval?

Mr. Drahotsky: If you will permit me, Mr. Chairman, I will ask Dr. Wagner to outline briefly how the budgetary process works and what the consultative arrangements are.

Dr. Sydney Wagner, General Director, Office of Science and Technology, Department of Industry, Trade and Commerce: Thank you, Mr. Chairman.

There is a formal process for budget submission in the department. This does not particularly involve formal arrangements with MOSST per se, but there is a formal procedure established between the department and Treasury Board for preparing a budget, as has been explained already. Our expenditures do appear in such a form as to allow the scientific expenditures to be clearly identified. There is not a requirement for us individually to formally consult with MOSST, but MOSST sees the scientific expenditures separated out, and they then have a consultative arrangement with Treasury Board, although there are informal consultations between ourselves and MOSST during the budget-setting process.

The Chairman: So that in a way you do have discussions with MOSST, although informal, before your estimates are reviewed and considered by Treasury Board?

Dr. Wagner: Yes, we have so many informal contacts with MOSST that I don't know that I would use exactly those particular words, but there are informal consultations, yes.

Senator Bourget: But, Mr. Chairman, if I may be permitted to ask a question following yours, is there a special committee discussing grants or money paid for industry? I think that was the point of your question. What is the set-up between your department and MOSST?

Mr. Drahotsky: If I may, Mr. Chairman, I believe that Dr. Wagner is trying to put across the fact that there is no formal procedure to consult systematically on all elements of the departmental budget interdepartmentally. There are informal consultations which would be carried on at the level of what we call the responsibility centres, in this case the Office of Science and Technology, with respect to the elements of budget falling under other responsibility centres—for example, trade promotion. They would carry out their own consultative processes, but at this stage there is no formalized consultative process and, to the best of my knowledge, the same thing applies to the budget formulation procedures of other government departments.

The Chairman: For instance, did you consult MOSST before deciding to abandon IRDIA?

Mr. Drahotsky: That decision, to the best of my knowledge, was a decision that was essentially political, taken by ministers in the context of the program to reduce expenditures. We obviously, as a department, provided inputs into that process in terms of our views on the relative cost effectiveness of the various programs, which was one of the considerations which, of course, played a significant role in the decision to phase out IRDIA, but that decision itself was a top-level political decision.

The Chairman: So there was no time at the official level to have consultations?

Mr. Drahotsky: There was not, Mr. Chairman.

The Chairman: That satisfies me, for the moment.

Senator Grosart: In that connection, Mr. Chairman, wouldn't these committees, such as the interdepartmental committee on industrial policies and strategies, which your department chairs, and the interdepartmental committee on industrial technology policy, be consulted or would they not at least be aware of what you are proposing in the way of science activity expenditures? There is also the trade

and industry committee. Perhaps you would tell us the relationship between these committees. We have three committees here with almost the same titles. What do they do? How often do they meet? Do they keep minutes? Have they chairmen?

Mr. Drahotsky: The interdepartmental committee on industrial technology policy which was, as I suggested, a replacement for the interdepartmental committee on innovation, along the lines of your committee's proposals, became operative two years ago, if my memory serves me correctly, and focused mainly on a review of the existing programs with a view to arriving at, first of all, some sort of framework which would allow an assessment of the effectiveness of the various technology-oriented as well as other programs in place; and, secondly, to provide a basis against which either individual departments, including MOSST, or the committee collectively could make recommendations to ministers on how to improve or reorganize these programs. That was essentially the focus of that particular committee.

Senator Grosart: Has it finished its work now?

Mr. Drahotsky: I believe it was described to you by MOSST as being dormant at that stage. They are undertaking an assessment of the activities of this committee, and also an assessment of what its relationships to the other interdepartmental committees, such as the interdepartmental committee on industrial policies and strategies, ought to be. The latter committee, ICIPS, if I may call it so, was set up as part of the new approach for the development of industrial sector policies. Its initial mandate relates to the identification of policy issues rather than to the discussion of budgetary matters.

Senator Grosart: What is the difference?

Mr. Drahotsky: I suppose the difference is that many policy initiatives may be developed which do not necessarily involve the use of additional resources but that may simply involve the use of existing financial resources under existing categories. In some instances they may involve elements such as changes in levels of tariff protection or in restraint agreements with certain countries. There is a variety of elements that any particular policy package may have. In the few that I have been involved with over the past few years, I believe most of the initiatives have not necessarily involved the use of financial resources. Others do. A shipbuilding strategy, for example, obviously relies mainly on a budgetary element.

Senator Bourget: Talking about shipbuilding program, is this done through an agency in Montreal or is there a private organization?

Mr. Drahotsky: No, I believe the transportation development agency reports to the Minister of Transport and was established, in fact, by the Ministry of Transport.

Senator Bourget: What part does your department play in it? Do you give grants, or what type of assistance? Is it technical, or what is it?

Mr. Drahotsky: In the context of the shipbuilding?

Senator Bourget: Yes.

Mr. Drahotsky: These are essentially grants in support of modernization of shipyards, to increase their capability to penetrate and compete in export markets. This is a direct subsidy program to shipyards.

Senator Bourget: Particularly for ships that will go to the Arctic, is that it?

Mr. Drahotsky: Not necessarily, but they would qualify for such support if they met the specific conditions of the program. However, the main objective of the shipbuilding program is to enable Canadian shipyards to compete in international markets. As you know, most countries provide some type of assistance to the shipyards.

Senator Grosart: You mentioned the Trade and Industry Council. What is its relationship to the other two?

Mr. Drahotsky: The Trade and Industry Council is an international management type of mechanism. As I mentioned, it is chaired by the minister. It was established originally by Mr. Gillespie, and has been carried on by Mr. Jamieson. Its main function is to ensure proper coordination of departmental activities. It has no inter-departmental responsibilities.

Senator Grosart: How do these committees operate? One is dormant; one apparently deals only with policies and strategies outside the expenditure context; and the Trade and Industry Council deals, I understand now, with inter-departmental coordination. Do these committees hold regular meetings, have regular chairmen and minutes? Do they respond to referrals? I am not suggesting this as fact—or do they alternatively just sit around and talk about whatever comes up? Do they have an agenda? How do they operate?

Mr. Drahotsky: Starting with the interdepartmental committee on industrial technology policy, chaired by MOSST...

Senator Grosart: That is the dormant one?

Mr. Drahotsky: That is the dormant one.

Senator Grosart: Who is the chairman?

Mr. Drahotsky: It used to be chaired by one of the assistant secretaries of MOSST, who at that time was Dr. Pierre Bourgault. It had a work program which was developed and agreed on by the members of the committee. It met not on a regular basis but, I would say, at least once every two months. It had a fairly wide participation in terms of interdepartmental representation. I believe that is as much as I can say about it.

Senator Grosart: Did it keep minutes?

Mr. Drahotsky: It did keep minutes. It generated and considered during its rather short term of life a surprising amount of issues and programs. I suppose one can say that it had not been in operation long enough to refine its procedures adequately to be able to generate specific conclusions. There is no doubt, however, in my mind that if the work had been carried on this would have gradually emerged.

Senator Grosart: I believe you said that it was dormant at the moment. Is it dormant or dead?

The Chairman: The difference between the Senate and Heaven!

Mr. Drahotsky: Mr. Chairman, I do not believe I used either of those terms.

Senator Grosart: Excuse me, I think you did; I believe you said it was "dormant."

Senator Carter: I believe he said that Mr. Drury said it was dormant.

Mr. Drahotsky: I am sorry; I was simply quoting what I understood was reported to you by the MOSST representatives. I am not qualified at this stage to interpret that particular term.

Senator Grosart: But your department is an active member of it. I do not wish to push this too far.

The Chairman: You are not a member of the committee, are you?

Mr. Drahotsky: Yes, sir; I was a member of the committee when it was in operation.

The Chairman: When was the last time it met?

Senator Grosart: I do not wish to pursue this, because I believe I know probably some grounds for some embarrassment in this respect. However, I would like to pursue its work. My understanding was that its function or object was to assess or reassess the 10 or 11 industrial support programs. Was that its specific function?

Mr. Drahotsky: Its specific function, if I remember correctly—and this is going back a number of years—was to identify the scope there was at that time for initiatives to encourage the development of “indigenous technological capability in Canada”—I believe I have the right words. That was its mission.

Senator Grosart: So, it did not have a mandate to review the 10 or 11 industry support programs of the department, is that correct? Not specifically, I mean.

Mr. Drahotsky: That was one of the specific responsibilities which it had in the context of coming up with the recommendations in relation to its primary objective.

Senator Grosart: So, then, did it come up with specific recommendations as to what should happen in the future to these 10 or 11 programs, or has anyone come up with specific recommendations?

Mr. Drahotsky: That committee has not as yet come up with specific proposals in a systematic fashion as to how existing or new programs could be developed to meet the particular objective.

Senator Grosart: I will ask a further question and preface it by saying that my understanding is that these 10 or 11 programs, many of which you have named, have been developed over the years as the response of the Department of Industry, Trade and Commerce to this problem of establishing a competent level of Canadian research and development and carrying it into innovation in industry. In view of the recent happenings, two of the three major programs having had their grants drastically reduced and one being deceased, could you assess the history, the effectiveness of these programs? The reason I ask this is not in a witch-hunting sense at all, but to obtain some idea of what will replace them. What is the new strategy that the interdepartmental committee on industrial policies and strategies has come up with? Specifically, I wonder if you intend to return to the self-generating income tax arrangements which, by and large, these programs replaced, or is there any other alternative? As I say, two are drastically reduced and one is defunct. Where are we?

Mr. Drahotsky: If I may say so, Mr. Chairman, that is a tall order, but I will certainly try to do my best to respond, hopefully in a meaningful manner, as much as I can.

The Chairman: Give us a first instalment.

Mr. Drahotsky: We have looked at two of the three technology-oriented programs in the department, namely the PAIT program, the program for advancement of industry and technology, and the DIP program, the defence industry productivity program.

To comment on the efficiency of these programs is, as I am sure Mr. Chairman and honourable senators will realize, a very difficult matter. First you have to ask what was the objective of those programs, in the first place. The defence industry's program was created, as you know, to meet requirements of a particular environment within which the defence industry found themselves following the cancellation of the Avro Arrow project. The purpose was to enable them to restructure their operations . . .

Senator Grosart: Excuse me. Could I make the question simpler, because the chairman has asked us not to go into the detailed programs? I was really asking you for an assessment in toto. These programs represented for a number of years the department's response to this broad problem. I am asking you now, have they met their objectives in toto, have they been cost effective? I am really asking you for an opinion rather than trying to tie you down to a specific assessment.

Mr. Drahotsky: With all due respect, senator, that is where I do have difficulty, because these programs were not developed originally to impact, in toto, on the Canadian economy, to impact in toto on the manufacturing sector, or to stimulate a general, overall increase in innovative activity in Canada.

Each of those programs—that is why I approached my reply in that context—was developed to meet a specific, perceived need. If I may say so, you are not the first who has tried to cast these programs in this broad context, in the context of a broader mission; but I have yet to see a methodology, or an approach, which would enable anyone to make that kind of judgment, a judgment on the broad impact of our programs, because initially they were not really designed for that purpose. With all due respect, I would like to suggest that if you want to pass a judgment on the impact of these programs, you have really to do that in relation to the narrowest definition of their objective.

Senator Grosart: I agree with that, but, on the other hand, all the evidence we have had indicates that each one of these has been developed to meet a perceived need in the broad program, and we have to assume that, putting them together, this is the response of Industry, Trade and Commerce to the broad problem. However, could I be more specific? As a result of all these programs, has there been a significant increase in the efficiency of Canadian industry in the areas of research, development and innovation in the years over which these programs have been operated? Surely your department must be assessing this. You must be able to tell us whether we are better off than we were when we started our hearings.

Mr. Drahotsky: This, senator, brings me back to the question of how you measure the increase in innovative performance and/or efficiency of the Canadian economy. I would suggest to you that we find many different answers to that particular question.

Senator Grosart: Would you care to give us *your* answer?

Mr. Drahotsky: We have done our best over the past two years to throw some light on this very question, and there is still an incomplete, unfinished review under way which attempts to approach the same question from a different angle. I believe I am safe in reporting at this stage that we have failed so far to come up with a technique which would enable us to judge the impact of our programs on these broad parameters of industrial or innovative performance which you have defined. We can assess them in the context of the narrow objective for which they have been designed.

Senator Grosart: Mr. Chairman, I said I would pass here and let someone else continue.

The Chairman: Perhaps we shall have a further opportunity when we deal with the new programs. Once we have done this, we may have a more global perception of the impact of these programs.

Senator Carter: Senator Grosart covered a good deal of what I wanted to ask. In MOSST and IT&C there are a number of common objectives. There are interdepartmental committees to consult and a policy committee to develop technological policy. In what context do you try to develop those policies and strategies? To make my question clearer, I might illustrate. High technology, for example, in the experience of most countries and of scientists, is a very fruitful source of new jobs and of manufacturing products for the export trade. In the light of our problems of unemployment, trade deficits, and so on, are these factors the context in which you develop your policy; and, if so, what particular things are you doing, what criteria are you using, to develop certain programs, and particularly, specifically what are you doing with respect to high technology?

Mr. Drahotsky: Mr. Chairman, this question is related to some of the questions posed by Senator Grosart. It might help us to reduce the various elements of the problem to a more manageable basis. The support programs which we have developed over the past six or seven years, as I have already suggested, were all designed to meet specific, perceived, or real needs. The PAIT program, for example, was introduced in the recognition that the level of product development in Canadian industry was not quite up to what at that time was judged as being the required level, mainly on the basis of comparisons with the innovative performance of other countries. PAIT was a response to remedy that deficiency and to encourage product development in Canadian industry. That was its only purpose. Its purpose was not to generate a higher level of R&D per se or to generate greater expenditures on R&D in Canadian industry. Its primary purpose was to encourage firms to develop new products by the application of either existing technology or new technology, and whether they might be developed by themselves or acquired.

That was the context within which the program was developed. As I have already indicated, the DID program was developed in a completely different context, to deal with a completely different problem, but, again, a specific problem—that is, what should we do with our defence industries when a major project, which provides a great deal of employment and activity in the industry, is suddenly cancelled? That was the perceived problem at that time, and DIP was developed to meet that particular problem.

IRDIA, the Industrial Research and Development Incentives Act, was developed to encourage a greater degree of innovative activity across the spectrum of Canadian industry. That, I believe, is the only general incentives program that the department has ever developed. In the context of that particular program, it is proper to ask, in my view, whether it has really encouraged a significant increase in the level of innovative activity in Canada. And the next question is how one measures that level of innovative activity.

I do not know whether I have answered your question. What I am really saying is that specific programs are developed in the context of specific needs, identified at a particular point in time.

The Chairman: Surely these programs, either directly or indirectly, are related to improving innovative performance in Canadian industry?

Senator Grosart: They all have the same objective.

The Chairman: Have they improved the innovative performance of Canadian industry?

Mr. Drahotsky: In that context, you are quite right, Mr. Chairman. In a way, all our activities are designed to assist the department in discharging its mandate, its mandate being to promote the development of efficient and internationally competitive industry. There is no doubt about that. If you consider that there is a hierarchy of objectives, it is at that point where everything meets. The difficulty arises when one tries to assess the contribution of the various sub-activities, if I may use that term, to the achievement of this broader objective, because the sub-activities have been formulated and initiated to meet other objectives. There is no doubt that all this, in some way, has to fit into the overall framework of our activity in the context of the broader objective, which is to promote efficiency and international competitiveness.

Senator Grosart: Surely, is it the major responsibility of the department to carry out this measuring? The department is spending millions of dollars in public funds. I cannot believe that you are saying you cannot measure its effectiveness, or that the department does not measure its effectiveness overall. Surely, this is what you are doing when you make these changes? Does this mean that you have serious doubts about the effectiveness of these programs? I am not being critical. Every country in the world has tried this and has had problems coming up with specific answers to specific problems that will add up to the total objective. I do not want you to think we are being critical when asking these questions. We have looked at England, Germany, The Netherlands, and even Sweden and Switzerland, and they are all experiencing these problems. One of the jobs we simply have to do, as a committee, is to determine what is right or what is wrong. We have to determine whether to continue with these separate programs, reduce them, put them all under one program, or go back to the self-generating tax incentive. We have to be alarmed by the present situation in which two of the major programs are being reduced and one is being discontinued completely. We have to be concerned about what is going to happen to this total objective, which is so important to Canada, as Senator Carter has said, in so many ways.

Senator Bourget: You must have had some reaction from the companies. Perhaps you did not expect this kind of question to be put to you this afternoon, but I think it is a very important one for the committee to consider.

Mr. Drahotsky: I quite agree that perhaps it is the most important question facing, not only your committee but the government, particularly in a period of budgetary constraints. We have to justify our expenditures, and I can assure you that the pressure is on, both from the political level and from Treasury Board. All we have succeeded in doing so far, to some extent, is in making some judgments on these programs in the context of the objectives which they have been designed to meet.

Dr. Wagner could give you an opinion as to the extent to which IRDIA has been successful, or otherwise, in the context of the objectives which it was designed to meet. Similarly, we could give you a judgment on the extent to which the DIP program has succeeded in meeting its objectives; and the same for PAIT. It can be done in that fashion. We can look at the activities under the program, assess the results in pragmatic terms, and make what is, essentially, a judgment.

The Chairman: To be a little more specific, one criterion would be the figures on our merchandise trade balance published recently by the *Financial Post*—and I have seen similar figures elsewhere. Looking at those figures, one can observe that our exports were more or less in balance between 1960 and 1965; that we moved towards a growing surplus position from 1965 to 1970; and that we have experienced a declining trend since 1970. The figures indicate that in 1975 we will probably experience a deficit in the order of \$800 million in merchandise trade.

Over this entire period, the great element of strength in our export trade was raw materials; our chronic deficit was in the area of higher technology manufactures, which has fluctuated during the entire period between 1960 and 1970 around \$2.5 billion.

This deficit began to increase rapidly in 1970, reaching about \$8 billion in 1975. These figures would indicate, it seems to me, a very serious and grave deterioration in our balance of trade in spite of your programs. Would you give us an assessment of the effectiveness of your programs in this kind of perspective of a growing, and rapidly growing, deficit in higher technology manufactures in Canada?

Mr. Drahotsky: With all due respect, I would have to ask whether it is reasonable to assume that our innovation oriented programs, which in total come to something like \$100 million, can be expected to have a significant impact on our balance of payments. I would also suggest that the trends in our merchandise trade performance are due to all sorts of changes, mainly economic changes, in Canada and abroad, in drastic shifts in price relationships between manufactured goods and basic commodities, in certain happenings in the energy area. I would suggest that it would be too much to expect that an effort of the order of magnitude which we are currently putting into the innovation programs in our department could really be expected to have a significant impact on that particular problem, which is a real problem.

The Chairman: Involving development of technology in Canada?

Mr. Drahotsky: That is just one element of the problem.

The Chairman: Involving?

Mr. Drahotsky: Right, but that is just one element of the problem as we face this tremendous deficit. I would suggest that in that context innovation activity is a relatively small part of the problem, which is far more fundamental

and which will require far more wide sweeping policy changes to deal with.

Perhaps I might be permitted to go on, because this is a very useful discussion from our point of view, and I hope also from your point of view. I should like to remind senators that, by and large, our programs have been responsive; we have not made an effort, as a deliberate policy decisions, to direct innovative activity in Canadian industry. We have provided a support framework, which it is essentially up to Canadian industry, on the basis of the private decision-making process, to take advantage of. That may be a wrong policy approach. Other countries have tried different approaches. I am not aware of any major country that has reaped significant economic benefits by using the registre approach. These are the options that we obviously face in Canada. So far we have used the responsive approach. This is the fundamental option.

Senator Grosart: That is, making offers and seeking responses, not responsive in terms of the department responding to needs and problems? When you say "responsive," do you mean in the sense that you are making an offer and are waiting for a response?

Mr. Drahotsky: No. It is even more responsive than that, although I stand to be corrected. We make it known that we have certain programs, but essentially we leave it up to the private sector to make the judgment whether or not it wishes to take advantage of those programs.

Senator Grosart: That is what I meant.

Mr. Drahotsky: It is completely responsive.

The Chairman: Senator Carter, we interrupted you.

Senator Carter: What I was trying to get at when I asked the question was this. I started out by asking in what context you develop your policies. You told us earlier that the programs you had were in a narrow framework, responding to one particular need, and after a period of time you decided they were not meeting that need sufficiently, so they were discontinued. To do that, somebody must have made an assessment of these programs in terms of the objectives and whether you can measure their productivity or their utility. Somebody made an assessment of them in some way, so there must be a methodology for that. What are you doing now? Are you just responding to requests from industry, or do you have a broad concept of objectives which you feel your department, along with MOSST, should be meeting? Are you developing a policy in that respect?

I mentioned two things. The chairman graphically described these two great needs we have, which can be helped by more concentration on higher technology; they do create jobs and they do produce new products that are marketable to offset our trade balance. What needs are you trying to meet now? Are these the two needs you are trying to meet, or do you have some other specific needs, or do you have no needs at all except the needs that industry comes along with?

Mr. Drahotsky: That still relates to this fundamental question of what strategy, if you wish, you use to implement it.

Senator Carter: What are your priorities? What are your main considerations at this time? In what way do you determine priorities? When I am talking with you I am assuming that you and MOSST are working together on

this, that you each keep the other informed, that you are working out a joint policy, a joint strategy. If that is not so perhaps you would correct me.

Mr. Drahotsky: Let me try to answer you in this way. Given the responsive approach to our innovative programs, in the way we have administered them so far—in a way it is amazing—the question of priorities has never arisen, because I believe we have never overspent in any fiscal year; hence, the question of how to allocate the resources within a particular program framework has not arisen. We are now shifting into a more systematic approach to industrial policy development in a global sense, based on the set of strategies which are in the process of being developed for major segments of Canadian industry. The objective of those strategies is to systematically identify the opportunities and constraints which the various sectors of Canadian industry face, and to develop approaches involving government policy that would assist those sectors in exploiting the opportunities and minimizing the constraints.

As a result of that process, we would hope to be able to start setting priorities. This should provide us with a base where we would deliberately favour a particular sector of industry, where a need for a higher level of innovative activity has been identified as an opportunity to improve its performance, as against other sectors, where perhaps innovation has been not as important in the total context of its performance or where the level of innovative performance is judged to be adequate.

The Chairman: Surely you do not mean that you started all these programs without having any system of priorities, and without ever assessing them, in terms of their objectives?

Mr. Drahotsky: Well, that might lead us into the very interesting subject...

The Chairman: This is the substance of our discussion.

Mr. Drahotsky:—of setting priorities in the government system.

The Chairman: I understood you to say that you had not.

Senator Grosart: I think perhaps you are misunderstanding the use of the word "priorities." We are not using it in the Treasury Board budget sense here at all. What occurs to me immediately is that as long as I can remember the Science Council, and everybody else, has been saying that what Canada must specialize in are the things that suit our domestic circumstances and things we can do best—that is, types of innovation related to our climate and so on.

Has the department done this? Has the department said, "All right, we are going to go out and make Canada the top people in the world in the permafrost field" or something like that? Has the department taken the initiative and said, "We are going to do this. We are going to work on it"?

Senator Neiman: Mr. Chairman, just following up what Senator Grosart has already said, have you looked at all these various setups or groups of different projects which we might undertake as Canadians and which might be especially effective and worthwhile from our point of view? Whatever the project might be, has your department done this over the years? Have they looked at the areas where we can really contribute and develop technology

that would not only be helpful to us but which could eventually export?

Mr. Drahotsky: I do not think it would be difficult to produce a list of the areas that ought to be exploited in Canada, using either unique Canadian capabilities or meeting unique Canadian conditions and requirements. Senator Grosart suggests that those areas have been sufficiently identified by the Science Council and by others. The next question then is, how do you exploit those opportunities? What levers have you at your disposal to move those areas?

I believe I am being fair in saying that, with a few significant exceptions, not all of them have been that successful. The department has taken the position that it is up to the private sector to identify the opportunities that exist for the establishment of either manufacturing activities or innovative activities. In the final analysis the question is not whether we pool resources into innovation, for the sake of promotion, but whether we use our admittedly limited resources to exploit those areas of innovative activity which have a promise of being successful in a commercial and financial sense. Our approach so far has been the responsibility for identifying the areas which are commercially promising, and that responsibility lies with the private sector.

We have deviated from that particular posture in a number of circumstances, where perhaps we have taken a stronger stand. STOL is an example, the PT-6 engine, on which STOL is based, is an example. I am sure we could cite a number of others. Also the MIL project is an example. That has been the approach so far.

Senator Neiman: I may be wrong in my recollection, but I recall a couple of years ago, I think it was our Ministry or Urban Affairs said it had \$100 million set aside to put towards the development of different types of housing. Surely, this is an obvious example where government is moving in and deliberately trying to encourage innovative technology to move in? I would think your department could be doing the same thing in many areas.

It is extremely difficult to leave this in isolation to various parts of industry, and the function of government should be to move in today. This is where we are so weak. I believe we have to move in at this point and do something more positive, not just react.

Mr. Drahotsky: I think I can fairly say that indeed we have done so. The DIP program was a deliberate attempt to impart a certain direction to a particular segment of Canadian industry. The shipbuilding program was an attempt to impart a particular direction to a particular segment of Canadian industry; and also the automotive program.

So, to that extent and in that context, the department has done so. It has undertaken fairly strong initiatives in support of a particular segment of Canadian industry, either to exploit an opportunity, as in the defence sector, or to assist a segment which was under competitive pressures, and to adjust to those pressures.

Senator Lang: I would ask one question with respect to the article you referred to from the *Financial Post*. During the last five years the developed countries of the world have been subjected to roughly the same sort of economic conditions, and yet, notwithstanding that, apparently in Canada we are rapidly losing our relative position to the rest of the developed world in technology, R & D and

innovative capacity. Can you identify what factors might be inhibiting us in this area to a greater extent than those factors are inhibiting other countries in the western world?

Mr. Drahotsky: I can, of course. I suspect I will be repeating what other witnesses have been saying to you before. If you would like me to, I will try. They can be listed, but not necessarily in the order of their priority or on the basis of their impact. I suppose the main inhibiting factor is the ownership structure of Canadian industry, which is not particularly conducive to innovation. Secondly, there is the impact of the fact that we live alongside, and are highly influenced in our spending habits by, the largest and most efficient and competitive economic system in the world. There is the fact that our highly-protected environment—and by “protected” I mean in terms of tariff protection—reduces somewhat the need to keep abreast of technological developments. It tends to take the heat off the protected sectors of Canadian industry.

The closeness to a highly sophisticated and highly technological society makes it very simple to purchase technology, which is always easier and less risky than to develop it yourself.

In that sense I believe Canada is unique among the industrialized countries, and I would even say among all countries in the world. There is no other country I can think of which faces this particular configuration of factors which might militate against innovation. It might be of interest to note that we are not the only ones facing a sudden decline in innovative activity.

Senator Lang: My question was really directed towards our relative position.

Mr. Drahotsky: Relative in terms of our innovative performance?

Senator Lang: Our relative position, as established five years ago, say, with respect to the other industrialized countries today. I think your answer has been directed towards that. Would you care to elaborate on what you mean by the peculiarities of our ownership structure and the impact of U.S. spending habits on our country?

Mr. Drahotsky: By the “ownership structure” I mean the fact that over 60 per cent of Canadian manufacturing industry is owned and controlled abroad. By the “spending patterns exhibited by Canadians” I mean the fact that our preferences, our choices, with regard to what we buy, and our reasons for buying certain things, are highly influenced by American spending habits.

I think one of the things that strikes you most in Europe is that the European consumer sets a high priority on a differentiated product, on a distinct product. In my view, Canadians, although there has been improvement lately, do tend to focus on a non-differentiated product.

One thing that never fails to impress me, when traveling through the European Common Market countries, is the fact that in spite of more than 10 years of experience of the Common Market, in most of the countries most of the consumer goods are still manufactured within individual

countries, with the exception of typical exotic products such as French wine and German sausages. It is an amazing observation, that despite the economic union, which has been in existence for over 10 years, the individual markets still exhibit a high degree of product differentiation. I would suggest that this is because the consumers in those countries insist on that degree of product differentiation, whereas a Canadian consumer, except in regard to certain product categories, does not insist on it. He wants to buy what the other fellow buys.

The Chairman: It is now rather late in the afternoon. I propose that we adjourn at this stage. We have perhaps been a little unfair to our guests by asking them general questions, but I hope that they will see now some of the concerns of this committee. They might want to go back and perhaps prepare more specific answers to some of the questions which have been asked this afternoon, and then come back with some kind of statement next week. Would that be satisfactory? And would it be satisfactory to members of the committee? I think it is essential that we get more direct answers than we have had this afternoon.

Senator Carter: Before we adjourn, for the sake of continuity, could I ask one question so that it will be on the record of today's proceedings?

The Chairman: Yes, senator.

Senator Carter: Mr. Drahotsky, you referred several times, I think in response to Senator Bourget's question, to the shipbuilding program. Can you tell me how that came about? Did the approach come from the shipbuilding industry, or did the government take the initiative, and on what basis was the shipbuilding industry chosen as compared to other deserving projects which might require the same help?

Mr. Drahotsky: Mr. Chairman, could I take this question under advisement and deal with it at the next meeting?

The Chairman: I think that was the purpose of the question.

I hope our schedule will be fairly regular, starting next week. Apparently, according to Senator Bourget, who is now our committee coordinator, we will probably meet at the same time next week and be able to continue to do so from then on.

Senator Bourget: I hope so, Mr. Chairman. As you know, my program is not finalized yet, but I hope we will be able to adjourn in the Seate at 3.30 p.m. and have the opportunity of sitting at an exact time. This afternoon we started at 4, or a little past 4. I cannot promise that we will be able to achieve what we have in mind, of course. We will need the approval of the two leaders, and even the deputy leaders.

The Chairman: On your behalf, honourable senators, I would like to thank our guests, and apologize to them for starting late this afternoon. I hope that we will be more on schedule next week.

The committee adjourned.

APPENDIX "18"

DEPARTMENT OF INDUSTRY, TRADE AND COMMERCE

S U B M I S S I O N

T O

THE SENATE OF CANADA

SPECIAL COMMITTEE ON SCIENCE POLICY

DECEMBER, 1975

TABLE OF CONTENTS

	<u>Page</u>
INTRODUCTION	1
A. DEPARTMENTAL ORGANIZATION AND RESPONSIBILITIES	1
Organization	1
Statutory Responsibilities	1
Responsibilities in Relation to Other Federal Departments and Agencies	1
Responsibilities in Relation to Industry	2
Responsibilities in Relation to Educational Institutions and Provincial Research Councils	2
Responsibilities in Relation to International Scientific Activities	3
B. ITC ASSISTANCE TO INDUSTRY	5
Research Development and Innovation Programs	5
C. INDUSTRIAL DEVELOPMENT POLICY	7
Background	7
Consultative Framework	8
Industry Sector Strategies	8
D. SMALL BUSINESS	9
Background	9
Decentralization	10
Federal Development Business Bank	10
E. OTHER MATTERS OF CONCERN TO THE SENATE COMMITTEE	11
Centre for Joint Ventures and Turnkey Projects	11
Inventors	12
Scientific and Technical Information	13

APPENDICES

	<u>Page</u>
A. ORGANIZATION CHART, DEPARTMENT OF INDUSTRY, TRADE & COMMERCE . . .	14
B. INTER-DEPARTMENTAL AND ADVISORY COMMITTEES HAVING DITC REPRESENTATION	15
C. INDUSTRIAL RESEARCH INSTITUTE PROGRAM	17
D. CENTRES OF ADVANCED TECHNOLOGY PROGRAM INDUSTRIAL RESEARCH ASSOCIATION PROGRAM	20
E. UNIVERSITY GRANT PROGRAM	24
F. INTERNATIONAL AGREEMENTS ON DEFENCE RELATED SCIENTIFIC ACTIVITIES	25
G. INDUSTRIAL RESEARCH AND DEVELOPMENT INCENTIVES ACT	27
H. PROGRAM FOR THE ADVANCEMENT OF INDUSTRIAL TECHNOLOGY (PAIT) . . .	33
I. THE DEFENCE INDUSTRY PRODUCTIVITY PROGRAM (Development Projects) .	46

INTRODUCTION

1. This brief has been prepared in response to Senator Lamontagne's letter of September 17, 1975 inviting the Department to provide the Senate Special Committee on Science Policy with current information regarding the Department's scientific activities where changes have been made since the Department submitted its previous brief in April, 1969. The brief reflects our understanding that the Ministry of State for Science and Technology (MOSST) will be reporting for all the departments on scientific expenses and personnel.

A. DEPARTMENTAL ORGANIZATION AND RESPONSIBILITIESOrganization

2. In 1969 the formation of ITC from the predecessor Departments of Industry, and Trade and Commerce had only just taken place. The most suitable organization to discharge the responsibilities of the new unified Department remained to be developed. Accordingly, the Department has undergone a major reorganization in 1973 and is currently realigning functions in order to integrate more closely its international trade promotion and industrial development responsibilities. Appendix "A" shows the present organization and identifies those units involved in funding scientific activities.

Statutory Responsibilities

3. The statutory functions and powers of the Department are set out in Part III of the Government Organization Act, 1969 and were fully described in ITC's brief to the Committee in 1969. There have been no changes.

Responsibilities in Relation to Other Federal Departments and Agencies

4. ITC's functions and responsibilities in relation to other Federal Departments and Agencies is to ensure that industry's needs are known and understood and that to the maximum extent possible these needs are taken into account in the planning and execution of their scientific and technological activities. Conversely the Department seeks the views and technical advice of other departments where these may be relevant to industrial development. This two-way flow of information and advice takes place through a variety of formal and informal contacts. An important component

4. (Cont'd.)

of this liaison is provided by external representation on ITC committees and ITC representation on the advisory committees of other departments and agencies. A list of the more important of these committees is presented as appendix "B".

Responsibilities in Relation to Industry

5. The Department's responsibilities in relation to industry are set out in the Government Organization Act, previously referred to, and were discussed in the earlier brief.

Responsibilities in Relation to Educational Institutions and Provincial Research Councils

6. The Department has no direct responsibility for educational institutes or provincial research councils. However, as stated in its earlier brief, ITC has introduced a number of measures designed to promote closer relations between these organizations and industry in the belief that both have much to gain.
7. The Department's first attempt to foster this closer liaison between the academic and industrial communities was the Industrial Research Institute Program, which was described in detail in the previous brief. During the period 1970-75 the Program was instrumental in establishing five new institutes in addition to the original four. The original four and one of those established subsequently are now independent of ITC financial support. A description of the Program and list of the Institutes is given in Appendix "C".
8. From the experience gained in establishing Industrial Research Institutes, it became apparent that there was a need not only for organizations offering industry a broad technical competence but also for organizations which specialized in specific technological areas.
9. In order to encourage the creation of centres of excellence in specific technological areas, ITC established a program of grants to universities and provincial research councils for the establishment of Centres of Advanced Technology and to industrially sponsored organizations for the establishment of Industrial Research Associations. To date, the Department

9. (Cont'd.)

has supported the establishment of eight Centres of Advanced Technology and three Industrial Research Associations, which are listed in Appendix "D".

10. The Senate Committee in its report expressed concern that little had been done in Canada "to study the practices and results of innovative strategies", and that the schools of management should be "the main centres of research on the complex problems of R&D management and innovation strategies". The Department shared this concern and in 1970 instituted a program to award grants to members of University faculties of commerce, economics and business administration to study the process of, and impediments to technological innovation and its management in Canada. This program is described in Appendix "E".

Responsibilities in Relation to International Scientific Activities

11. Commencing in 1970, the Canadian Government initiated new policy instruments to formalize Canada's relations in science and technology with selected industrialized countries. Agreements which Canada signed with USSR (January 1971), Belgium (April 1971) and the Federal Republic of Germany (April 1971) and the exchange of science and technology missions to identify mutual interests and areas for cooperation brought a new dimension to Canada's scientific and economic relations with other countries.
12. These initiatives developed from a belief that while certain exchanges take place without government involvement, there was a need for an additional mechanism to exploit adequately the accelerated scientific and technological advances in other industrialized economies. From an economic point of view ITC regards this activity as a means of identifying and transferring technology that is of interest to Canadian industry, and of developing interest in Canada as a supplier and partner in the development of new technology.
13. Since the Canada/USSR Agreement on Cooperation in the Industrial Application of Science and Technology is more directly related to trade and industrial interests than the other two Agreements its implementation is coordinated on the Canadian side by the Department of Industry, Trade and Commerce. For the other two Agreements, ITC is represented on the Canada/FRG Consultative Committee and the Canada/Belgium Mixed Commission.

14. The Department is also actively involved in developing scientific and technological cooperation with other countries where no formal agreements exist such as Japan, the United Kingdom, and France. As with formal agreements, the primary objective of the Department is to facilitate the acquisition of foreign technology by Canadian industry, and in particular focus attention on the systematic utilization of applied research which is relevant to Canada's needs and opportunities.
15. In recent years there has been a significant expansion in the science and technology activities of multilateral organizations, such as the Organization for Economic Cooperation and Development (OECD), North Atlantic Treaty Organization NATO, and the United Nations (UN). The Department participates in many of the activities focussed on the application of technology for industrial development and innovation.
16. This participation has been useful to ITC in analyzing and assessing the science and technology policies of other countries to promote technology transfer and industrial innovation, and in monitoring the changing international industrial and environmental conditions which are of interest to Canadian industry.
17. In the context of international cooperation, particular mention should be made of the Department's initiative with respect to relations with the European Economic Communities (EEC).
18. Since about 1965 there have been a succession of groups created within the EEC to develop policies and plans to coordinate applied research by the Member Governments. The EEC is now well advanced in the process of articulating an overall science and technology policy for which some of the important elements appear to be already in place. These activities range from the coordination of applied research in a number of areas to the development on a European scale of high technology industries in specific sectors. As the scope of the Commission's responsibility increases, the usefulness of direct cooperation with the EEC has become more important. Accordingly ITC has commenced informal discussions with the European Commission to identify potential areas for scientific and technological cooperation.

19. The Department is also involved in international scientific activities through its responsibility for the development, production, and marketing of defence related equipment to meet the needs of Canada and allied countries. To this end cooperative agreements have been signed with a number of countries. A list of the formal enabling agreements to which ITC is a party, directly or indirectly, is given in Appendix "F".
20. Under the formal enabling or "umbrella" agreements there are a multitude of specific project agreements. These project agreements relate to the development of such specific equipments as the CL-89 and CL-289 reconnaissance drones.
21. The Department also has a close continuing interest in numerous agreements between other departments and foreign governmental or international agencies. Such agreements include the various defence scientific agreements between the scientific establishments of DND and the equivalent agencies of other countries; the numerous agreements and arrangements under the North Atlantic Treaty Organization agreements. The Technical Cooperation Program (TTCP) defence science agreement among the former DRB and the equivalent agencies in Britain, the U.S.A., Australia and New Zealand; the A.B.C.A. agreement among the armies of Canada, the U.S.A., Britain, and Australia; the comparable Air Standardization Coordinating Committee (ASCC) agreement among the air forces of the same countries; and the Information Exchange Programs (IEP) among the same nations' naval elements.

B. ITC ASSISTANCE TO INDUSTRY

Research, Development and Innovation Programs

22. To help industry upgrade its technological capability ITC has three assistance programs:

The Industrial Research and Development Incentives
Act (IRDIA)

The Program for the Advancement of Industrial
Technology (PAIT)

The Defence Industry Productivity (DIP)
Program.

Since ITC last reported to the Committee a number of changes have been made in these programs, which are described in Appendix "G-I".

23. Prior to 1970 assistance under the PAIT Program was provided in the form of a conditional loan. If a project was successful and the results were put into commercial use, the firm was obliged to repay the program contribution with interest. These financial terms and conditions were more onerous than those of any other support program. As a result, industry did not respond to the program as well as expected and the program did not grow as rapidly as considered necessary to encourage Canadian industry to achieve a level of developmental activity comparable to that of industry in other countries with which it must compete.
24. In 1970 the program was amended to place assistance on a contribution basis where costs were shared 50-50 with industry, and to expand the program to cover such activities as pre-production expense and market studies related to the development project. Assistance amounting to over 50% of the costs may be provided on an interest-free loan basis, forgivable if the project failed or the results were not put into commercial use.
25. More recently steps have been taken to decentralize the administration of the Program in order to make it easier for small companies to obtain assistance.
26. The Industrial Research and Development Act and the Regulations were amended in 1970 to remove anomalies and to clarify certain provisions. The Regulations were further amended recently to clarify the eligibility of expenditures made for the acquisition of used general purpose equipment. In January 1971, the procedures for administration of the Act were changed in order to permit advance partial payment of the grant claimed in order to reduce the delay between application and payment.
27. Following the decision of the Department of National Defence to phase-out the Defence Industrial Research (DIR) Program ITC extended support under the DIP Program to applied research projects of the type previously supported by the DIR Program.
28. In its report the Senate Committee recommended that "all existing specific grants designed to encourage R&D activities in industry be integrated into one multi-purpose program, and be administered by the Department of Industry, Trade and Commerce ...". In this connection it may be noted that the functions previously covered by the DIR Program have, as noted above, been assumed by the DIP Program administered by ITC. Furthermore, in the course of the development of the new industrial development policy, which will be

28. (Cont'd.)

discussed in a later section of this brief, the need was identified for a fundamental restructuring of ITC's industrial support program framework. As a result a review of the programs is now taking place, and while it would be premature to prejudge the conclusions of this review it can be stated that one objective is to replace the present multiplicity of programs, each with its own narrow objective, criteria and procedures, by a single comprehensive program.

C. INDUSTRIAL DEVELOPMENT POLICYBackground

29. In 1975 ITC presented proposals to Cabinet for a new industrial development policy which would initiate policies to take advantage of the opportunities made available by the dynamic domestic and external environment, national social needs, and government priorities.

30. These industrial policy proposals:

- a) defined the role which the federal government ought to play in industrial development and proposed a set of industrial policy goals;
- b) identified the major factors which will have a bearing on Canadian industrial development over the next decade. Among these factors are the rate of technological change and the need to improve the technological performance and capability of Canadian industry;
- c) outlined a framework for the development of policies and programs which would be responsive to the specialized needs of individual industry sectors;
- d) identified a need for a more coherent approach to industrial development policy based on improved mechanisms for consultation and coordination both within the federal government, and with provincial governments, industry and organized labour.

Cabinet approved the recommendations and authorized ITC to proceed with their implementation.

Consultative Framework

31. In response to the Cabinet's instructions ITC placed before Cabinet in February, 1975 a memorandum on the Consultative Framework which identified appropriate consultative mechanisms and proposed that an Interdepartmental Committee on Industrial Policies and Strategies (ICIPS) be established. These recommendations were accepted.
32. The Interdepartmental Committee on Industrial Policies and Strategies is chaired by the Deputy Minister of ITC, and comprises senior officials of the Departments of Finance, Regional Economic Expansion, Labour, Manpower and Immigration, Consumer and Corporate Affairs, Energy, Mines and Resources, Transport, the Offices of the Privy Council and of Federal Provincial Relations, and the National Research Council.
33. ICIPS is primarily a coordinating mechanism and is intended to:
- a) enable ITC to obtain inputs from other departments relevant to the development of sector strategies;
 - b) make it possible to identify at an early stage major policy issues which have a bearing on industrial policy development;
 - c) provide a forum for other departments to discuss issues which, in their view, would have industrial development implications.
34. From an operational point of view ICIPS concentrates on the identification of issues and ways and means of dealing with them. The substantive work will still be carried out by the departments concerned or by interdepartmental sub-committees established for that purpose.

Industry Sector Strategies

35. In the past sector strategies were in most cases designed to respond to special problems arising from the weaknesses of particular sectors. It is only recently that it has proved possible to move to the identification and implementation of strategies based on potential strengths.

36. Moreover, recent developments have significantly altered the competitive positions of major sectors of Canadian industry. From an international economy predicated on surpluses of petroleum and energy supplies, of other metal and mineral resources, and of food supplies, the world scene has shifted to one of wide-spread shortages and increased costs for many of these crucial natural resources. This shift has presented important opportunities to exploit our comparative strengths in industries dependent on these resources. This requires new or modified sector strategies, drawing upon Canadian manpower, capital and technical capabilities in the exploitation of these natural resources opportunities.
37. The development of industry sector strategies is an ongoing activity in ITC. Strategies for a number of sectors have already been developed, and some have been implemented e.g. Shipbuilding and Repair and the Footwear and Tanning Industries.
38. The special needs and requirements of sector strategies are being taken into account in the review of ITC's industrial support programs which is currently underway. It is envisaged that any new program structure would allow for the development and implementation of sector strategies without having to create specific new programs as in the past.

D. SMALL BUSINESS

Background

39. The Senate Committee stressed the important role which could be played by small business provided that assistance was available to overcome their management and financial weaknesses. Among other things, the Senate Committee recommended:

"That a lending and investing institution called the Canadian Innovation Bank (CIB) be created to support in cooperation with private venture capital companies the activities involved with the launching of technological innovations, especially in new or existing small and medium-sized firms, to provide managerial services to these enterprises and to be responsible to the Department of Industry, Trade and Commerce."

40. The Department is in full agreement with the Senate Committee on the importance of small and medium-sized firms, which comprise 50 to 60 percent of the business enterprises in Canada. Accordingly it has taken a number of steps to make the existing programs and services of the Department more easily available to small business. In addition it has proposed and implemented new initiatives specifically designed to assist the smaller company.

Decentralization

41. The Regional Offices of ITC have been strengthened, and steps are being taken to decentralize further the administration of the department's industrial assistance programs. For example applications for assistance under the Program for the Advancement of Industrial Technology (PAIT) from small companies are already being handled on a regional basis.

Federal Business Development Bank

42. Studies made by the Department have shown that, while financing remains a major problem for small business, management deficiencies are of equal importance. Accordingly ITC established the Counselling Assistance to Small Enterprises (CASE) Program in 1972. Recently the Department took steps to bring together into one institution financial and management assistance and information on government programs and assistance. It is anticipated that some of the deficiencies identified by Mr. Grasley will be rectified by this action. (See paragraph 54)
43. The need for bringing together in one institution, with a regionally oriented office structure, programs to meet three basic needs of small business: an expanded and more flexible financing program, a management counselling and training program, and an information and guidance program specifically directed to the needs of small businesses formed the basis for the legislation in 1974 establishing the Federal Business Development Bank (FBDB).

44. The objectives of the Federal Business Development Bank are to promote the formation and development of viable business enterprises in Canada, giving particular attention to small business, by supplementing other sources of financing, counselling and management training programs and by providing an information service.
45. The Bank uses new flexible lending techniques as well as emphasis on equity financing. The new Bank has been given powers to enable it to provide a full range of financial services. Information services - particularly on federal assistance programs - are intended to involve advice and personal referral as well as documentary information.
46. The Bank will provide management services, counselling and management training. The existing program to provide Counselling Assistance to Small Enterprises (CASE) has been expanded and transferred from ITC to FBDB.

E. OTHER MATTERS OF CONCERN TO THE SENATE COMMITTEE

47. In the second volume of their report the Senate Committee recommended that the scope, composition and authority of the Interdepartmental Committee on Innovation be enlarged, and that the chairmanship be transferred from ITC to MOSST.
48. ITC accepted the recommendation that MOSST provide the chairmanship of the Innovation Committee. The Committee has, however, not been active as its functions and responsibilities have been largely assumed by the Interdepartmental Committee on Industrial Policies and Strategies, chaired by ITC, and the Interdepartmental Committee on Industrial Technology Policy, chaired by MOSST.

Centre for Joint Ventures and Turnkey Projects

49. The Senate Committee recommended that MOSST and ITC develop a "marriage bureau" for Canadian firms "which are free to develop new products and services for expediting partnerships between these Canadian firms and complementary companies in other countries, including the sponsoring of industrial visits abroad".

50. In relation to the above recommendation the Department has established a new centre for the promotion and marketing abroad of Canadian capability to participate in multi-disciplinary industrial projects either as a turnkey project or as a joint venture to establish a continuing industrial or service operation in a foreign country. The purpose of this Centre is to provide a focal point of contact in the Department through which businessmen can obtain information and guidance when pursuing such projects abroad. The main thrust of the Centre is to encourage and support the efforts of the private sector and in particular to seek out Canadian companies interested in pursuing identified opportunities.
51. The Centre works actively with interested companies to ensure that the most effective Canadian proposals are advanced and is responsible for arranging whatever specialized support or assistance that may be necessary to promote a particular bid.
52. Information on potential joint venture opportunities is developed from a number of sources, for example, from our Trade Commissioner Posts abroad and through direct contact such as Ministerial missions. The Centre brings these opportunities to the attention of interested and competent Canadian partners and offers whatever guidance possible from the government in pursuing such opportunities.

Inventors

53. The Senate Committee was concerned with the difficulties faced by the individual private inventor in Canada and recommended that ITC investigate the factors having an important effect on the private inventor, the types of public assistance provided by other countries, and consider whether a Canadian inventors council should be established to assist private inventors and act as their formal spokesman. The Department has also provided financial assistance on an experimental basis to the Copyright, Inventions and Patents Association of Canada (CIPAC) in its efforts to become the national spokesman for the private inventor.
54. Consideration has been given to whether the role of Canada Patents and Developments Limited could be expanded to include assistance to the private inventor. MOSST also commissioned a study by Mr. Robert Grasley on the availability of risk capital for technological innovation and

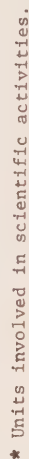
54. (Cont'd.)

invention in Canada. It is expected that some of the deficiencies identified by Mr. Grasley **will be met by the FBDB.**

Scientific and Technical Information

55. The Department is considering a proposal to establish "technology transfer units" to serve selected sectors of Canadian industry. The government would provide financial support for the initial costs involved in their establishment.
56. The proposed units are in many ways, similar to the initiatives taken in the past to establish Industrial Research Institutes, Industrial Research Associations and Centres of Advanced Technology, all of which perform some technology transfer function. Although the proposed Units will be involved exclusively with technology transfer activities in the initial phases, we anticipate that their future development may involve the addition of testing facilities and, later, full-fledged R&D capability. If this should occur, then we would end up with units which are similar to Centres of Advanced Technology, except that they would be oriented towards a sector of industry instead of a field of technology.
57. Continuation and expansion of the program would be dependent on the proposed units success in their ability to finance their activities through user fees.
58. The Senate Committee stressed the importance of technological forecasting and recommended that government activities in this area be strengthened. ITC's technological forecasting activities will be discussed in the separate brief which is being submitted on "futures".

APPENDIX "A"



APPENDIX "B"INTER-DEPARTMENTAL AND ADVISORY COMMITTEES HAVING DITC
REPRESENTATION

Advisory Committee, Program for Advancement of Industrial Technology

Inter-Departmental Committee for Defence Industry Productivity

Aerospace Advisory Group

General Technology Advisory Group

Electronics Advisory Group

National Research Council, Associate Committee on Tribology

National Research Council, Associate Committee on Avionics

National Research Council, Associate Committee on Aerodynamics

National Research Council, Associate Committee on Aerospace Structure and Materials

National Research Council, Associate Committee on Agricultural and Forestry Aviation

National Research Council, Associate Committee on Air Cushion Technology

National Research Council, Associate Committee on Grants and Scholarships - Sub-Committee on Negotiated Grants

National Research Council, Associate Committee on Propulsion

National Research Council, Associate Committee on Automatic Control

National Research Council, Advisory Committee, Industrial Research Assistance Program

National Advisory Committee on Mining and Metallurgical Research - Physical Metallurgy Subcommittee

Inter-Departmental Committee on Space

Inter-Departmental Committee on Development, Research and Evaluation of Agricultural Machinery

Senior Advisory Committee on DHC-7 Program

Inter-Departmental Committee on Air Cushion Technology - icebreaking
- ferries

Ad hoc Inter-Departmental Committee on Transportation Control Systems

Inter-Departmental Committee on Submersibles and Undersea Technology

Inter-Departmental Committee on Exchange of Science and Technology Agreement between Federal Republic of Germany and Canada

Canadian Committee on Oceanography

Advisory Group on R&D - Marine Pollution

Advisory Board - Canada Institute for Scientific and Technical Information

Panel on Energy Research and Development

Inter-Departmental Committee on Northern Development-Subcommittee on Science and Technology

Inter-Departmental Urban Transportation Committee

Inter-Departmental Committee on Industrial Policies and Strategies

Inter-Departmental Committee on the Environment

Ad Hoc Inter-Departmental Committee on OECD Study of the Impact of Multinational Enterprises on National and Scientific Potentials

Advisory Committee for the Defence Science Contracting Program

Public Service Inventors Committee

Advisory Committee on Fusion Canada

NATO Advisory Group for Aerospace R&D

Inter-Departmental Committee on Space - Sub-Committee on Industrial Aspects of Space Policy

Inter-Agency Committee on Remote Sensing

Ad Hoc Inter-Departmental Committee on International Electronic Data Processing

Activities

Inter-Departmental Committee on Computers/Communications - Working Group 4, 8 & 11

Inter-Departmental Committee on Research and Development in Municipal Sewage Collection and Treatment

Advisory Committee on the Shuttle Attached Remote Manipulator System

UHF Satellite Policy Steering Group

APPENDIX "C"INDUSTRIAL RESEARCH INSTITUTE PROGRAM1.0 Program Objectives

1.1 The objectives of the program are:

- (a) to foster a closer relationship between universities and industry, thus assisting the universities to improve their understanding of the problems of industry, and helping industry to become acquainted with the latest pertinent scientific and technical developments;
- (b) to facilitate transfer of science and advanced technology to industry;
- (c) to provide scientific services for industrial firms unable to maintain research facilities and personnel of their own.

2.0 Program Authority

2.1 Treasury Board Minute No. 708798 dated January 17, 1972.

3.0 History

- 3.1 During 1966, a formal request was submitted to the Department by the University of Windsor, for a grant to assist in the establishment of an Industrial Research Institute to serve local industry. A preliminary proposal, received during the previous year, had been endorsed by the Windsor Chamber of Commerce.
- 3.2 In December of 1966, a recommendation to the Treasury Board resulted in the approval of a grant to the University of Windsor, as well as the approval to assist in the establishment of Institutes at Nova Scotia Technical College, McMaster University and the University of Waterloo. The Industrial Research Institutes formed at these four universities began the acquisition of staff, and made preliminary contacts with industry during 1967.
- 3.3 By mid 1973, these four institutes had become self-supporting and a further five institutes had been created at McGill University, Ecole Polytechnique de Montréal, University of Quebec at Montreal, Ryerson Polytechnical Institute and the University of Manitoba.

3.4 By the end of 1975, the Institute at McGill had become self-supporting (after four years support) and that at Ecole Polytechnique had indicated that it would be self-supporting after five years of support. The remaining institutes are still developing and will require support over a five year period.

4.0 Eligibility Criteria

4.1 To qualify for assistance under the Program, Industrial Research Institutes must be wholly owned by a Canadian university and must utilize the facilities of the university to conduct contract research on behalf of industry.

5.0 Forms of Assistance

5.1 Under the Industrial Research Institute Program, assistance takes the form of a grant, payable in semi-annual instalments (in advance). The payments made in any one year are limited to an agreed maximum of less than \$60,000 and may be used to pay actual expenditures made by the university during the year for the following purposes:

- a) Salaries and wages, including fringe benefits, of the manager, and assistant manager (if any) of the Institute and of the secretarial and clerical staff of the Institute.
- b) Travel expenses incurred by the manager and assistant manager of the Institute.
- c) Rental of offices and office equipment, and the cost of office supplies, printing, telephone and telegraph services for the Institute.
- d) Other administrative expenses as may be approved by the Department.

6.0 Administration

6.1 Each Institute is managed by a full-time manager (or director), usually with an assistant, and a small secretarial and clerical staff. Each Institute operates with the guidance of an advisory board, or a board of directors. A representative of the Office of Science and Technology sits upon the board of each of the four institutes.

7.0 Expenditures

7.1 Expenditures incurred since the start of the program are shown below:

<u>1967/68</u>	<u>1968/69</u>	<u>1969/70</u>	<u>1970/71</u>	<u>1971/72</u>
\$109,206	\$120,912	\$174,719	\$140,614	\$270,146
<u>1972/73</u>	<u>1973/74</u>	<u>1974/75</u>		
\$322,853	\$415,019	\$245,383		

8.0 Results and Achievement

8.1 Nine institutes have been established. Five are now self-supporting and a sixth will be so in 1976.

8.2 Total annual contract income of the institutes has been rising steadily. In 1974, it amounted to \$2.4 million. The Waterloo Research Institute has been particularly successful: its annual contract income is now in excess of \$1 million.

APPENDIX "D"CENTRES OF ADVANCED TECHNOLOGY PROGRAM
INDUSTRIAL RESEARCH ASSOCIATION PROGRAM1.0 Program Objectives

1.1 The objectives of the programs are:

- a) to provide technical development assistance to industry in specific technological areas;
- b) to conduct research of benefit to industry in specific technological areas;
- c) to foster the establishment of research and development facilities that deal with the range of technological activities common to one industry sector.

2.0 Program Authority

2.1 Treasury Board Minute No. 708798 dated January 17, 1972.

3.0 History

- 3.1 From the experience gained in establishing Industrial Research Institutes, it became apparent that there was a need not only for organizations offering a broad technical competence but also for organizations which specialized in specific technological areas.
- 3.2 A case in point is the computer control of machine tools. This is a complex and rapidly developing technology which is highly relevant to the entire metalworking sector of industry.
- 3.3 In 1970, Treasury Board approval was obtained for the establishment of the Canadian Institute of Metalworking at McMaster University.
- 3.4 In 1971, the Systems Building Centre was established at the University of Toronto and the Centre for Powder Metallurgy at the Ontario Research Foundation.
- 3.5 In 1973, the Centre for Ocean Engineering was established at the British Columbia Research Council, the Systems Analysis, Control and Design Activity at the University of Western Ontario, the Sulphur Development Institute of Canada in Calgary and the Canadian Welding Development Institute in Toronto.

- 3.6 In 1974, the Centre for Ocean Technology was established at the Nova Scotia Research Foundation, the Canadian Food Products Development Centre at the Manitoba Research Council, the Centre de technologie de l'environnement at the Université de Sherbrooke, and the Canadian Gas Research Institute in Toronto.
- 3.7 Negotiations are in progress concerning additional centres at the University of Toronto, McGill University and the Ontario Research Foundation.

4.0 Eligibility Criteria

- 4.1 To qualify for assistance under the program, Centres of Advanced Technology must be wholly owned and sponsored by a Canadian university or a non-profit research organization such as a provincial research council. Industrial Research Associates must be sponsored by manufacturers associations representing specific industry sectors.

5.0 Form of Assistance

- 5.1 Under these programs, assistance takes the form of a grant, payable in semi-annual instalments in advance, over a 3 or 5 year period. Payments made in any one year are adjusted to cover actual expenditures incurred for the following purposes:

- a) salaries and wages of professional and support staff;
- b) purchase of specialized equipment;
- c) rental of accommodation;
- d) purchase of materials and supplies;
- e) travel and similar administrative expenses.

Generally, the maximum annual grant is \$175,000 but may be less where mutually agreeable to both parties. Larger grants may be paid in certain instances but Treasury Board approval is required for each specific grant in excess of \$175,000 per annum.

6.0 Administration

- 6.1 Each Centre has a director and a small professional and support staff. It operates under the guidance of an advisory board with members drawn from industry, universities, and provincial research associations as appropriate, and a representative of the Department of Industry, Trade and Commerce.

7.0 Expenditures

- 7.1 Expenditures since the commencement of the programs are as follows:

	<u>Centres</u>	<u>Research Associations</u>
		\$'000
1970/71	75	
1971/72	289	
1972/73	376	
1973/74	1,376	675
1974/75	937	763

8.0 Results and Achievements

- 8.1 Eight centres and three research associations are now operational. Two centres are independent of Departmental support.
- 8.2 The Centre for Ocean Engineering in Vancouver is currently constructing a towing tank/manoeuvring basin with additional funding from the Department and a grant from the B.C. government.
- 8.3 Grant support under the program to the Canadian Food Products Development Institute in Manitoba is being matched by a grant from the Province of Manitoba.
- 8.4 Since centres of advanced technology and industrial research associations must develop a technological capability that can be of assistance to industry, and this takes time, benefits from these programs are slower to mature than under the industrial research institute program. However, they are likely to be more profound. For example, although the Centre for Ocean Technology in Nova Scotia has been operational for only one year, it has been instrumental in the establishment of a new company providing sub-sea technical services. The work of the Sulphur Development Institute of Canada on foamed sulphur is likely to lead to a major improvement in the

8.4 (Cont'd.)

cold weather durability of roads. The Centre for Powder Metallurgy is currently assisting a tool manufacturer to adopt an entirely new manufacturing process.

APPENDIX "E"UNIVERSITY GRANT PROGRAM

1. The objectives of the Program are to encourage continuing interest by members of university faculties of commerce and economics in the process of, and impediments to, technological innovation and its management in Canada, and to generate relevant and useful information in the development of policy or program initiatives designed to improve the innovative performance of Canadian industry.

2. Prospective research topics are developed through extensive consultation with representatives from various groups within the department. These topics are then carefully reviewed by a selection committee made up of senior officers to ensure that the research topics finally selected are both useful and relevant to the work of the department.

3. Financial support of studies in the area of technological innovation or its management is necessary to counter-act the strong tendency of university business faculties to concentrate their efforts on what can be termed "status quo" business management and to neglect the problems of introducing change into business organizations in the form of new products or processes. This Program is the major source of funds for these studies.

4. Fifty-five projects have been funded among 11 universities as follows:

<u>Fiscal Year</u>	<u>71/72</u>	<u>72/73</u>	<u>73/74</u>	<u>74/75</u>	<u>75/76</u>
Funds Expended or required.	\$85,550	199,363	270,435	231,250	219,600*

* To be approved.

5. The program has had two main results. The first is the generation of a considerable body of knowledge which is made freely available to potential users both in government and in industry, and which consists of the 41 reports received to date, and numerous published papers, articles and books. The second is the development of a group of knowledgeable Canadian individuals, which is growing in terms of size and influence, and which acts as a valuable resource to both industry and government.

APPENDIX "F"INTERNATIONAL AGREEMENTS ON DEFENCE RELATED SCIENTIFIC ACTIVITIES1. Canada - U.S.A.

- 1.1 Canada - United States Defence Production Sharing Arrangement 1959 and 1963.
- 1.2 Memorandum of Understanding in the field of Cooperative Development (complements the Canada-U.S.A. Defence Production Sharing Program by establishing a cooperative program in defence research and development).

2. Canada - Federal Republic of Germany

- 2.1 Memorandum of Understanding regarding defence research, development and production (RDP) programs between the then Department of Defence Production and the German Ministry of Defence (1964). Provides for cooperation and collaboration in the field of defence industrial development and production so that duplication of effort for common defence requirements can be avoided.
- 2.2 Agreement between Canada and the German Ministry of Scientific Research concerning the use of the Churchill research range for scientific purposes and the establishment of a real telemetry station at Churchill (1969). Signed by the Secretary of State for External Affairs, and involves, in addition, NRC, the Departments of Finance and Revenue Canada (Customs & Excise).
- 2.3 Agreement between Canada and Germany on Scientific and Technical Cooperation (1971).

3. Canada - France

- 3.1 Intergovernmental agreement between Canada and France for Cooperation in Research, Development and Production of Defence Equipment (1967).

4. Canada - United Kingdom

- 4.1 Memorandum of Understanding between Canada and Britain on Cooperation in Defence Research, Development and Production (1974).

5. Canada - Italy

- 5.1 Memorandum of Agreement between Canada and Italy on Cooperation in Research, Development and Production of Defence Equipment (1972).

6. Canada - Netherlands

- 6.1 Netherlands/Canada Arrangement for Consultation on Cooperative Research, Development and Production (of Defence Equipment), (1970).

7. Canada - Sweden

- 7.1 Agreement between Canada and Sweden concerning Defence Research, Development and Production (1975).

APPENDIX "G"INDUSTRIAL RESEARCH AND DEVELOPMENT INCENTIVES ACT1. Program Objectives

1.1 The objective of the Industrial Research and Development Incentives Act (IRDIA) is to induce Canadian corporations to expand scientific research and development likely to result in economic benefit to Canada. The specific objectives of the Act are:

- a) to encourage an increased growth rate in industrial research and development by:
 - (i) inducing Canadian corporations to undertake new and expand existing scientific research and development programs, the results of which, if successful, will be exploited by the Corporations;
 - (ii) inducing Canadian corporations to provide well equipped facilities for such work.
- b) to encourage the establishment of independent research and development laboratories, research associations and technical consulting services whose purpose is to provide specialized support services for industrial research and development;
- c) to encourage greater cooperation between industry and universities on research related to industrial problems.

2. Program Authority

2.1 The authority for this program is the Industrial Research and Development Incentives Act, 14-15-16 Elizabeth II, Chapter 82 of the Statutes of Canada. The Act was assented to March 10, 1967. Industrial Research and Development Incentives Regulations were promulgated in Order-in-Council P.C. 1967-1048 dated May 25, 1967.

3. Eligible Applicants

- 3.1 The incentive is available to all taxable Canadian corporations carrying on business in Canada.

4. Qualifying Activities

- 4.1 The activities qualified for assistance under the Act are scientific research and development as defined in Section 2(2)(d) of the Regulations, which state: "Scientific research and development" means systematic investigation or search carried out in a field of science or technology by means of experiment or analysis, that is to say,

- (i) basic research, namely, work undertaken for the advancement of scientific knowledge without a specific practical application in view,
- (ii) applied research, namely, work undertaken for the advancement of scientific knowledge with a specific practical application in view, and
- (iii) development, namely, use of the results of basic or applied research for the purpose of creating new, or improving existing, materials, devices, products or processes,

and where such activities are undertaken directly in support of scientific research and development, includes activities with respect to engineering or design, operations research, mathematical analysis or computer programming and psychological research, but does not include activities with respect to -

- (iv) market research or sales promotion,
- (v) quality control or routine testing of materials, devices or products,
- (vi) research in the social sciences or the humanities,
- (vii) prospecting, exploring or drilling for or producing minerals, petroleum or natural gas,

- (viii) the commercial production of a new or improved material, device or product or the commercial use of a new or improved process,
- (ix) style changes, or
- (x) routine data collection.

5. Form of Assistance

- 5.1 Assistance is provided in the form of tax free cash grants. At the request of the applicant company, a cheque will be forwarded to the Department of National Revenue as a credit on account of any income tax which is or may become payable under the Income Tax Act.

6. Allowable Costs

6.1 Capital Costs

- 6.1.1 Grants of 25 percent of capital expenditures made by an applicant for scientific research and development carried out in Canada during the grant year. These expenditures must be related to the business of the applicant and directly undertaken by or on behalf of the applicant.

6.2 Current Costs

- 6.2.1 Grants of 25 percent of the increase of eligible current expenditures made by the applicant in Canada over the average of such expenditures in a base period consisting of the five immediately preceding years.
- 6.2.2 The terms "capital expenditures" and "current expenditures" are defined in Section 2(2)(a) and (b) of the Regulations.

7. Terms of Repayment

- 7.1 The Act does not require repayments as such, but grants may be recovered in other instances if property for which a grant has been authorized is transferred from research and development use to some other use.

8. Title to Results and Property

- 8.1 The title of any results of property arising out of the program, e.g., designs, inventions, patents, prototypes, equipment, etc., remains with the Corporation.

9. Obligations of Applicant

- 9.1 A Corporation that applies for a grant shall certify, with respect to scientific research and development carried out, that was financed in whole or in part by the Corporation, that:

- a) It is carrying out all such scientific research and development for the purpose of strengthening the business of the corporation or facilitating an extension of such business.
- b) It is free to exploit in Canada the results of all such scientific research and development, and the corporation is free to exploit the results of all such scientific research and development in all export markets (where this is not possible, will state the countries to which the corporation is not free to export) and shall undertake to exploit the results of such scientific research and development in Canada, unless according to sound business judgement, it would be uneconomic to do so.

10. Administrative Procedures

- 10.1 The administration of the program is controlled centrally by the IRDIA Program Office.
- 10.2 Industry Sector Branch or Branches prepare an assessment and recommendation concerning the scientific research and development and benefit to Canada aspects of each application.

- 10.3 The Financial Analysis Division of the Financial Services Branch then carry out a financial assessment on behalf of the Program Office and if necessary recalculate the grant to be paid.
- 10.4 The Program Office reviews the application, and under normal circumstances, the Chief of the Program Office authorizes a grant on behalf of the Minister. A committee procedure is not followed in the administration of the Program.
- 10.5 In the case of major policy questions or rejections of applications the Program Office may seek the assistance of Legal Services or other Government Departments and obtain the concurrence of the Office of Science and Technology and the Program Office - Industry.
- 10.6 Requests for cheques to be issued by the Department of Supply and Services are requested through the Controller.
- 10.7 Reassessments of completed applications which we requested within 90 days are arranged by the Program Office.
- 10.8 Administratively applicants may request a prior opinion as to eligibility under the Act with regard to research and development and Benefit to Canada aspects on work carried out.
- 10.9 Since January 1971 applicants having an acceptable record of performance under the program may be allowed an immediate partial payment up to 90% of the grant claimed upon receipt of the application.
- 10.10 All applications are subject to post-payment audit by the Audit Services Bureau of the Department of Supply and Services.

11. Expenditures

11.1	<u>Since the start of the program to 31 Oct 75</u>		
	Corporations who have applied		2,600
	Applications received		7,436
	Applications completed		6,682
	Total grants paid		\$208 (Million)
	Number and value in process	710	\$37 (Million)

- 11.2 The following is a breakdown for the expenditures for the years 1970-71 to 1974-75 up to 31 March 76.

<u>Government Fiscal Year</u>	<u>Applications Received</u>	<u>Grants Authorized</u> (Millions)
1970-71	855	\$30.1
1971-72	1,001	31.3
1972-73	1,075	32.1
1973-74	1,026	30.1
1974-75	1,049	27.0

11.3 The following is distribution of grants by provinces based on an average of the last five years:

<u>Province</u>	<u>Percentage of Grants Paid</u>
Newfoundland	.002
Prince Edward Island	.026
Nova Scotia	.547
New Brunswick	.279
Quebec	26.336
Ontario	59.525
Manitoba	1.104
Saskatchewan	.350
Alberta	7.572
British Columbia	4.262

APPENDIX "H"PROGRAM FOR THE ADVANCEMENT OF INDUSTRIAL TECHNOLOGY (PAIT)1. Program Objectives

- 1.1 The objective of the Program for the Advancement of Industrial Technology (PAIT) is to promote the growth of efficient, competitive manufacturing and processing industries in Canada by providing financial support for product and process development projects, the results of which will be marketed at home and abroad.
- 1.2 The program is designed to place Canadian industry in a position comparable to its foreign competition which enjoys larger markets, a higher level of investment in new product development, and substantial government support for its research and development activities. By providing direct assistance for product and process innovation in all sectors of Canadian industry, the PAIT Program promotes product specialization and rationalization based on technical innovation and access to international markets.

2. Program Authority

- 2.1 Under the authority granted in Section 7 of the Department of Industry Act, a proposal for the establishment of the Program for Advancement of Industrial Technology was put before the Cabinet in early 1965. A Record of Cabinet Decision dated April 14, 1965, formally established the program. Detailed terms and conditions for the operation of the program were submitted to the Treasury Board and were approved in Treasury Board Minute 644962 dated August 30, 1965. Subsequent revisions to the program have been covered by Treasury Board Minutes 693881 dated January 8, 1970, 724646 dated June 13, 1974 and 738080 dated October 9, 1975. Under these minutes, financial authority is delegated to the Deputy Minister.

3. Eligible Applicants

- 3.1 Assistance under the program is available to all companies incorporated in Canada or to groups of companies organized as consortia, also included are consulting firms, engineering and construction

3.1 (Cont'd.)

contractors and similar companies to the extent that they can satisfy the requirements of the program.

4. Qualifying Activities

4.1 PAIT assistance has been concentrated mainly on the engineering development phase of product and process innovation projects but has been broadened to include some non-recurring preproduction activities and marketing activities undertaken directly to define the required specifications of the product. Activities associated with the development may be conducted either in-house or by sub-contractors (firms, consultants, universities, research councils and foundations.)

5. Selection Criteria

5.1 Applicants are assessed as to their technical and financial resources and facilities. The management, technical and marketing skills of the company, and the corporate characteristics, are of special interest. The applicant is expected to have the engineering, production and marketing capability necessary to plan and implement the development project and exploit the results in domestic and export markets. The technical capability of the applicant is evaluated on the basis of previous work in the field, the availability of qualified staff, or of arrangements for technical competence on a sub-contract basis. Marketing skills are assessed on the basis of previous sales, the market survey, and the adequacy of the existing or planned marketing organization and distribution network. Corporate characteristics of interest are the record of past performance, the influence of foreign control, and any legal restrictions on access to international markets.

5.1.2 Regarding facilities, the applicant is expected to have the tools of the trade and equipment suitable for the conduct of the development project and follow-on manufacturing. If facilities are not adequate for these purposes, the applicant is required to outline firm plans on how he proposes to acquire them.

5.1.3 The financial status of the applicant is evaluated by analysis of his audited financial statements for the past three years. Financial resources should be adequate to enable the company to carry out the project on a sound financial basis, and there should be a satisfactory accounting system. If additional capital is required to undertake the project, or to exploit it commercially, the means of raising this capital are determined and assessed.

5.2 Project

5.2.1 Projects must be based on sound scientific principles, be technically feasible within the time and cost limits of the project, and be sufficiently advanced in performance to ensure that the developed product or process will be technically competitive by the time the marketing stage is reached. The main technical problems associated with the project should have been identified and the technical risks reduced to the practical minimum by the development plan proposed. A Statement of Work is drawn up and becomes part of the PAIT Assistance Agreement. The qualifications and experience of the technical personnel directly involved in the project should be adequate to perform the technical tasks outlined in the development plan.

5.2.2 The commercial feasibility of each project is also evaluated. The company is required to supply a market analysis defining the total market in terms of the requirement (price reduction, improved performance, simplicity, reliability, etc.), prospective customers, growth of market, distribution problems, and competition. Particular attention is given to export possibilities, and the proposed marketing plan. Where price is a critical factor, a production cost analysis is required.

6. Form of Assistance

6.1 PAIT assistance is provided as a grant, for up to 50% of the estimated cost of the project without reference to Treasury Board for contract authorization. Under exceptional circumstances, more than 50% of the

6.1 (Cont'd.)

costs can be provided by way of interest-free loans repayable from the results of the project subject to specific Treasury Board authorization.

7. Allowable Costs7.1 Capital Costs

7.1.1 The PAIT Program does not underwrite the costs of acquisition of buildings or general purpose capital equipment for research, development or production purposes. General purpose equipment is defined as equipment which has a useful life beyond the duration of the development project and can be utilized for purposes other than the development project without major modification or alteration, i.e., equipment which can be sold for more than scrap or salvage value or utilized for other research and development purposes or for production purposes. However, during the period in which such equipment is used for research and development purposes related to the project, its operating costs including an allowance for depreciation expense is allowable. This costing policy is also applied to prototype plants where the complete facility is larger than is essential for research and development purposes.

7.2. Current Costs

7.2.1 Allowable current costs include direct labour (research, design, development, fabrication), direct materials (all material inputs essential to development and test), prototypes or pilot plants, reasonable overhead charges (apportionment of such indirect costs as supervision, rent or taxes, depreciation, power and light, heat and insurance - excluded are selling and financing costs), subcontracts and consultants, special test and laboratory equipment consumed during the project, and such other direct costs as patents and necessary travel related to the project.

8. Terms of Repayment

8.1 Repayment of PAIT grants is not required. However, if the company sells, transfers to commercial use, or otherwise disposes of any equipment acquired for the project or manufactured by such equipment.

8.1 (Cont'd.)

and the Crown has shared in the cost of its acquisition, then the company may be required to repay prorata the proceeds or fair market values of such disposition.

9. Title to Results and Property

- 9.1 The title to all results and property (e.g. designs, inventions, patents, prototypes, equipment, etc.) vests in and remains with the company.

10. Obligations of Applicant

- 10.1 The applicant company must undertake that the product or process resulting from the project will be produced or used by the company in Canada and that the company will, within a reasonable period of time, exploit the results in accordance with sound business practice. In the event of non-exploitation, the Minister has the right of exercising remedies as specified in Clauses 5(4) and 10 of the PAIT Assistance Agreement.
- 10.2 The major condition imposed on the PAIT applicant company is the requirement not to transfer technical data or inventions, whether or not patented, methods and processes resulting from the project to any other government or to any person, company, partnership or firm outside of Canada for the purposes of production, without the prior consent of the Minister; and place the same restriction on any transfer it may make to another Canadian company, firm, partnership or person.

11. Administrative Procedures

- 11.1 Applications for PAIT assistance are generally received in the PAIT Program Office where they are allocated to the appropriate industry sector branch. Branch officers examine the applications within the context of the PAIT criteria and their knowledge of the industry. The PAIT Office also forwards a copy of the company's application to the Director (scientific) of the Office of Science and Technology who assigns the application to a Scientific Consultant for an appraisal of the technical content of the

11.1 (Cont'd.)

proposed project. The PAIT Office is instrumental in bringing together the branch officer and the Scientific Consultant for a comprehensive evaluation of the applicant's eligibility for assistance. Applications are usually in narrative form and are expected to set out in detail the technical aspects of the project, the market prospects and marketing plan, the cost estimate, the financial resources of the company, and its R&D capability. The Scientific Consultant is responsible for the technical appraisal, Financial Services Branch is responsible for the financial appraisal, and the PAIT Office is held responsible for ensuring that all other aspects are compatible with the program criteria and program objectives before submission of the application to the PAIT Advisory Committee. Applications are sponsored before the Committee by the industry sector branch.

11.2 For applications requesting assistance of less than \$200,000 from companies whose latest annual sales do not exceed \$2,000,000, the administration is handled on a regional basis. Applications are generally reviewed in the Regional Office, and are assigned to a project officer for assessment. Copies of the application are forwarded to the PAIT Office and to the appropriate industry sector branch for review, advice and guidance where required. Submissions to the Regional PAIT Advisory Committee are also submitted to the PAIT Office, appropriate industry sector branch and Financial Services Branch. Applications are sponsored before the Committee by the regional project officer.

11.3 The PAIT Advisory Committee is a senior interdepartmental committee, and is chaired by the General Director of the Office of Science and Technology. The Committee is composed as follows:

Chairman: General Director, Office of Science & Technology
Department of Industry, Trade & Commerce

Members: Department of Industry, Trade & Commerce (4)
 - ADM Industry Development
 - ADM Industrial Policies
 - ADM Export Development
 - General Director, Office of Design

Department of Finance

National Research Council

Department of National Defence

Department of Agriculture

Observers: Treasury Board Secretariat

Ministry of State for Science & Technology

Director, Financial Analysis Directorate
Department of Industry, Trade & Commerce

Secretary: Director of Program Activities
Department of Industry, Trade & Commerce

The Regional PAIT Advisory Committees are set up for each Regional Office in Canada and are typically constituted as follows:

Chairman: Director Regional Office
Department of Industry, Trade & Commerce

Members: Director General, Provincial Office -
Department of Regional Economic Expansion

Two regionally located senior executives of other federal government departments

Regional Coordinator - Counselling Assistance for Small Enterprises (CASE) program

Observers: Program Office - Industry
Department of Industry, Trade & Commerce (Ottawa)

Office of Science & Technology
Department of Industry, Trade & Commerce (Ottawa)

Program Development Division
Department of Industry, Trade & Commerce (Ottawa)

Secretary: Program Administrator, Regional Offices Branch
Department of Industry, Trade & Commerce

- 11.4 When an application for assistance is recommended for approval by the PAIT Advisory Committee, the PAIT Program Office raises a requisition to encumber funds from Vote 10, and processes it for the signature of the Deputy Minister or his designate (the final approval stage and authorization of funding). This action is required prior to the drawing up of a PAIT Assistance Agreement which

11.4 (Cont'd.)

is executed by an executive officer of the applicant company and by the Director of the industry sector branch or regional office concerned.

- 11.5 Following Committee recommendation and Deputy Minister funding authorization, the industry sector branch, or regional office becomes responsible for the monitoring of the project regarding both technical progress and approval of payment of progress claims, in consultation as appropriate with the PAIT Office and the Scientific Consultant. The PAIT Office monitors projects on a program basis, consolidating estimates, encumbering funds under Vote 10, and assisting the industry sector branch or regional office with termination agreements as required.

12. Expenditures

- 12.1 The Department expenditures on the program have been:

	\$'000
1965-66	428
1966-67	4,596
1967-68	6,364
1968-69	4,303
1969-70	5,289
1970-71	13,054
1971-72	27,427
1972-73	26,536
1973-74	25,557
1974-75	29,498
Total to March 31, 1975	143,059

- 12.2 The Program expenditures and their regional breakdown are given in Table I.

TABLE I

<u>F.Y.</u>	<u>Nfld.</u>	<u>N.S.</u>	<u>N.B.</u>	<u>P.E.I.</u>	<u>Que.</u>	<u>Ont.</u>	<u>Man.</u>	<u>Sask.</u>	<u>Alta.</u>	<u>B.C.</u>	<u>Total</u>
					----- \$'000 -----						
1968/69	-	40	11	-	1,875	1,926	-	29	195	227	4,303
1969/70	-	9	-	-	1,244	2,479	-	12	397	1,149	5,290
1970/71	-	3	13	-	3,676	6,739	130	67	528	1,902	13,055
1971/72	-	38	13	-	8,104	14,577	431	-	1,071	3,194	27,428
1972/73	-	36	28	8	6,295	16,500	444	36	720	2,470	26,537
1973/74	-	15	20	30	5,915	15,234	243	89	754	3,257	25,557
1974/75	-	95	9	9	5,309	18,175	187	86	876	4,753	29,499

13. Results and Achievements

- 13.1 Since the inception of the PAIT Program up to March 31, 1975 879 projects have been approved involving a total research and development expenditure of over \$477 million, of which the PAIT share is \$238.5 million. 447 projects have been completed or terminated prior to completion at December 31, 1974. 194 of these projects are expected to achieve sales. The remaining 253 projects were failures either in a technical, marketing or financial sense.
- 13.2 The 194 successful projects to date involved a total PAIT expenditure of \$28 million. The 253 unsuccessful projects were terminated at a cost to the Crown of \$25 million. Sales resulting from the 194 successful projects have reached nearly \$277 million (over half exported) by December 31, 1974. Actual and projected sales are expected to reach \$1.9 billion by 1979. In addition, 4100 new jobs are expected to be created.
- 13.3 The 194 successful projects cover a broad spectrum of industrial innovation including electromagnetic mineral prospecting equipment, environmental control instrumentation, communications, electronic data display devices, automated equipment, industrial process control techniques, and woods harvesting equipment.
- 13.4 The criteria for evaluating the results of a project are related to the economically regenerative aspects of industrial R&D:
- sales of price and performance competitive products of unique Canadian design in large domestic and export markets; and
 - value added as a measure of economic output and growth resulting from the project; and
 - benefits such as increased employment, establishment of new capital facilities and equipment for manufacturing of the developed product, upgraded employment skills, and advanced management and marketing techniques related to product innovation as a factor in modern business enterprise.

14. Case Histories of Successful Projects

14.1 Development of Roll Force Sensing System

This project concerns the development of load cells as a roll force sensing system for on-line computer control of metal rolling mills. This relatively small Ontario company has successfully developed a superior product which is being well received in the industry.

At the time of application only one other company, a Swedish firm, could provide equipment to this market. The company has successfully sold \$350,000 of systems to the end of 1973 with all production being exported. Sales of \$3.7 million are forecast to 1978. It is expected that up to 6 new jobs will result from this project.

A subsequent project for a tensiometer system has just recently been completed with indications that it will be equally successful.

PAIT contribution was \$68,000.

14.2 Development of Iron-Dextran

This project was undertaken by an Ontario company and concerned the development of iron-dextran for use in human and veterinary medicine for the treatment of iron deficiency anemia. The company successfully developed an improved process based on the application of membrane technology at several steps in the process.

Use of the process has resulted in substantial sales of the product. To December 31, 1973 actual sales reached \$800,000 with 95% being exported. Currently running at \$1 million per year, sales are forecast by the company to be \$14 million over the next 5 years. Up to 30 new jobs are expected to result.

PAIT contribution was \$187,815.

14.3 Development of Swine

An Alberta company undertook the development of a genetically superior breeding stock for supply to the Canadian swine industry. This project had to overcome a very high technical risk.

14.3 (Cont'd.)

There is a very large continuing demand for replacement breeding stock in North America. The company aimed at reducing the number of such hogs imported into Canada and improving exports to the U.S. To December 31, 1973 sales of the newly developed breeding stock amounted to \$665,000 of which approximately \$250,000 were export. The company's projection for the next 5 years is over \$8 million with 20% for the export market. Up to 11 new jobs are expected to result.

PAIT contribution was \$112,500.

14.4 Development of Underwater Cable Burying System

A British Columbia company developed an efficient underwater cable burying system to satisfy the requirements of telephone companies. Equipment was developed for use with a submersible to lay cable at water depths exceeding one mile.

Although manufacture and sale of equipment is unlikely to produce much revenue due to a limited demand, the company is now able to offer a service which is in good demand. Service sales to the end of 1973 already amounted to \$800,000 with 10% being for export. Company projections of additional revenue to 1978 are \$4.2 million. Of equal importance is the establishment in Canada of a high technology capability which has gained the company worldwide recognition.

PAIT contribution was \$31,320.

14.5 Development of Vehicle Emission Control Device

This project concerned the development of anti-pollution devices for use on automotive vehicles which would meet the legislated levels for 1975 in both Canada and the U.S. A number of devices were investigated and several were successfully put into production.

14.5 (Cont'd.)

The company is an OEM supplier to all major automobile manufacturers.

Acceptance of a product results in substantial sales for the model year of acceptance and probability of continuing business.

Sales to the end of December, 1973 had only amounted to \$41,000

but for 1974 are expected to exceed \$5 million. Total forecast

by the company to 1978 is over \$46 million with 90% being exported.

The company's plans include a capital investment of \$2.5 million

and the creation of 170 new jobs. The company praises the program

and has indicated that the PAIT support enabled them to build up

their research team and become better able to compete in this

difficult industry sector.

PAIT contribution was \$316,150.

APPENDIX "I"THE DEFENCE INDUSTRY PRODUCTIVITY PROGRAM
(Development Projects)1. Program Objectives

- 1.1 The objective is to develop and sustain the technological capability of Canadian industry for the purpose of defence export sales or civil export sales arising from that capability.
- 1.2 Such industrial capability is a means towards four main ends, two of which relate directly to national defence and constitute the initial and still valid aims of the Program:
 - a) To minimize cost of acquisition of equipment for the Department of National Defence (DND) (by making it possible to purchase abroad when necessary to achieve competitive prices), and
 - b) To retain in Canada defence industrial capability for use by DND in servicing and maintaining its advanced equipment (by substituting the opportunity of defence export sales, in place of dependence on DND requirements).
 - c) To ensure maximum industrial benefit from the advanced technology and management techniques inherent in defence research, development and production by making possible competitive participation in foreign markets.
 - d) To support cooperative programs with our Allies in Military Research, Development and Production (the Production Sharing Program).

2. Program Authority

- 2.1 In its present form, the Program was given approval on 1st May, 1968, by a Cabinet Committee considering a "Memorandum to the Cabinet" dated 24th April, 1968, and entitled "Defence Industrial Development". This approval was later confirmed by Cabinet.

3. Eligible Applicants

- 3.1 Assistance under the Program is available to companies identifiable as belonging to Canadian defence industry. This industry sector is defined as those companies or elements thereof which have or may develop a defence-oriented capability or capacity employing advanced management engineering and technology directed to defence export sales or civil export sales which arise from the capability or capacity.

4. Qualifying Activities

- 4.1 The activities which are eligible for assistance are product research, development, test, and evaluation and product and process innovation; tooling, manufacture of prototypes, sample batches and all other non-capital cost activities associated with the establishment and qualification of a production source; advanced manufacturing equipment; test and quality control facilities; data handling equipment.

5. Selection Criteria

5.1 Development Projects

The following considerations are taken into account when assessing a proposed project.

- a) the extent of production sharing potential,
- b) the extent of real interest within the applicable associated government service(s),
- c) the extent to which the associated government is prepared to monitor the project to ensure that the end-product meets its development specifications,
- d) the extent to which the resources of DND, such as technical assistance, test facilities, G.F.E., etc., may be available,
- e) the extent of Canadian military interest,
- f) the extent to which existing Canadian industry is capable of accepting the responsibility for development,

5.1 (Cont'd.)

- g) the extent of commercial implications,
- h) the extent to which Canadian industry is prepared to share financially,
- i) the extent of long range economic benefits to Canada in terms of technological advancement, financial advantages, continuity and suitability within the Canadian industrial engineering base.

6. Forms of Assistance6.1 Development Projects

The Crown's assistance is provided by means of a shared-cost contract. The particular sharing ratios of the total approved costs of the project can vary widely, depending upon various factors, including the number of participants in the project (e.g. costs could be contributed by the Crown, Company, and one or more allied Governments). Generally speaking, the Crown matches the Company's particular contribution. To date, on an overall basis, the Crown has contributed approximately 50% of the total costs of all development projects under this Program.

7. Terms of Repayment7.1 Development ProjectsRecoupment of Her Majesty's Contribution

- a) In normal circumstances the employment of funds is limited to those companies which are prepared to make an adequate contribution. In such cases, there is no recovery of the Government contribution except where the profit realized on the initially supported development and/or follow-on production orders is beyond that considered fair and reasonable. For the purpose of this assessment, an adequate contribution in support of the development contract equals or exceeds that of the Government.

7.1 (Cont'd.)

- b) In cases where the contractor is not able to make an adequate contribution (as defined above), a Government contribution is considered provided that any contract entered into with the company contains a condition that repayment will be made to the Government as follows:
- (i) 25% of all profits up to 10% and all profit in excess of 10% realized from the initially supported development contract and/or follow-on production until an equal contribution to the development project has been made by the company and the Government, and
- c) If the development project to which the Government has contributed results in the contractor becoming the sole source of supply, in addition to the profit arrangements set forth in a) and b) above, it is expected that the follow-on production orders will enable the contractor and the Government to recover simultaneously their contributions in whole or in part on a pro-rata basis, i.e. in the form of a Royalty payment. Recovery of the Government contribution will be at a rate to be determined in consultation with the Financial Advisor.
- d) As an alternative to refunding any amount to the Government, it may be arranged for the company to invest an equivalent amount on special projects, to be approved by the Department in advance, in the field of product development or source establishment.
- e) To determine the repayment position, costs are computed in accordance with DSS 1031 in the case of military requirements and in accordance with generally accepted accounting principles in the case of commercial sales. To determine profit, the company contributions, but not the Government contribution, to development costs, will be considered an element of cost. Recovery of profits over 10% arising from contracts placed by DSS on behalf of any Canadian Government Department is not applied against recovery of the Government contribution to development

e) (Cont'd.)

projects. It may be acceptable for the contractor to arrange for a statement to be submitted to the Department, certified by a responsible officer of the company, substantiating the profit position. In addition, each contract contains the Department's usual discretionary audit clause, which permits audit by A.S.B. Department of Supply and Services. The company must agree to an examination of the cost and profit position of the company resulting from the initially supported development contract and any follow-on orders.

8. Title to Results and Property8.1 Development Sharing Projects

The disposition of design rights is a negotiable point and depends on the circumstances (e.g. sharing ratio, participation of a foreign country, etc.) of the individual proposal.

9. Program Administration9.1 Development Projects

If after a general, overall review of a proposal the Department's opinion is favourable, it is referred to the appropriate Technical Advisory Group. (These groups are staffed by DITC, DND, DSS. These are three separate groups, namely, Aerospace, Electronics and Weapons). The TAG is responsible for determining the technical suitability of the proposal and reports to the Inter-Departmental Committee, Defence Export Development (IDC Committee). The IDC Committee membership is as follows:

Senior Assistant Deputy Minister, Department of Industry,
Trade and Commerce, Chairman

Assistant Deputy Minister (Material), Department of
National Defence

Chief, Research and Development, DND

Assistant Deputy Minister (Science & Engineering Procurement)
Department of Supply & Services

Assistant Deputy Minister, Industry Development, Industry,
Trade and Commerce

General Director, Office of Science and Technology,
Department of Industry, Trade and Commerce

Assistant Deputy Minister, Export Development,
Industry, Trade and Commerce

Assistant Secretary, Treasury Board (Observer)

General Director, Office of International Special
Projects Branch (Advisor) Industry, Trade and Commerce

This Committee serves as an Advisory Committee to the Treasury Board operating through the Department of Industry, Trade and Commerce. Contracts are prepared and administered by the Department of Supply and Services.

9.2 Follow-up of Approved Projects

For development projects a formal review group, the Project Review Group (consisting of members from DSS, ITC, and other Government agencies) is formed to monitor the project, recommend changes if necessary, and report regularly to the IDC Committee through the Technical Advisory Group.

10. Expenditures

10.1 The Program expenditures and their regional breakdown are given in Table 1.

TABLE 1

FY	Alberta	B.C.	Manitoba	N.B.	Nfld.	N.S.	Ontario	Quebec	Total
----- \$'000 -----									
1960/61	-	-	87	450	-	79	822	1,464	2,902
1961/62	275	-	251	-	-	209	1,483	2,202	4,420
1962/63	1	-	698	-	-	207	2,852	3,111	8,000
1963/64	395	-	344	-	-	-	8,961	9,300	19,000
1964/65	258	-	889	-	82	473	8,151	10,646	20,500
1965/66	199	-	349	331	136	123	8,061	14,698	23,898
1966/67	47	68	314	192	12	103	8,360	13,530	22,626
1967/68	140	51	705	521	-	345	6,322	14,818	22,903
1968/69	132	-	663	-	-	169	4,223	16,050	21,237
1969/70	138	-	258	-	-	8	7,495	15,924	23,823
1970/71	291	-	466	-	-	-	8,861	15,961	25,578
1971/72	121	-	446	-	-	-	11,506	19,796	31,870
1972/73	31	-	150	474	-	-	11,863	17,203	29,721
1973/74	84	-	174	232	-	371	26,008	17,478	44,346
1974/75	56	-	24	17	-	245	26,221	9,169	35,724

11. Case Histories of Successful Projects

11.1 Crash Position Indicator/Flight Data Recorder Leigh Instruments Limited

In 1962 Leigh Instruments Limited of Carleton Place, Ontario obtained a licence from National Research Council to exploit the Tumbling Airfoil principle in an aircraft crash position indicator. The equipment serves to locate the crash scene by emitting a radio signal at the site of the crash. The important feature of the system is the tumbling airfoil principle which assures that the equipment is thrown free of the aircraft and rapidly decelerated to effect a safe landing.

An appraisal of the market in 1962 indicated that a major industrial effort would be required to launch the product on the market. The company was too small to mount a sufficient effort without assistance. With the financial and marketing help of the Department it was possible to arrange for test installations of the equipment in U.S. Air Force transport planes. While tests of prototype models were being conducted assistance was provided to establish a production facility by arranging for component part sub-contracts from other Canadian manufacturers who were supplying the export aircraft market.

With the acceptance of the Crash Position Indicator by the U.S. Air Force and with the addition of Flight Data Recording equipment the Crash Position Indicator/Flight Data Recorder is now being sold generally throughout the world.

Vote funds invested in the development of the Crash Position Indicator/Flight Data Recorder are approximately \$1.6 million. Another \$500,000 has been invested in the development of a minaturized version of the equipment. To March 1974 sales totalling \$49 million have been reported.

11.2 AN/GRC - 103 Tactical Military Microwave Communications Weapon - Canadian Marconi Co. Ltd.

In 1961 Canadian Marconi, with the assistance of the Canadian Government, initiated development of a Tactical Military Microwave Communications System based on a U.S. Army requirement. Since 1961 four different equipments within the AN/GRC - 103 system has been developed with Crown assistance amounting to \$4.125 million.

So far the company has made sales to the Armed Forces of Canada, the United States, Pakistan, Norway, Sweden, Denmark, Nigeria, Zambia, New Zealand, Saudi Arabia, Iran, and Singapore totalling \$120 million. The equipment is still being manufactured and it is estimated that future sales may reach an additional \$75 million.

11.3 Satellite Communications Equipment RCA Limited

In 1961 the Program shared the cost of developing low noise communications systems with RCA Victor Co. Ltd. These systems were for use in satellite communications. By 1965 the work undertaken by the company had led to RCA receiving three significant contracts from NASA. The company was awarded the contract for systems integration of the Department of Transport Satellite Communication Ground Station at Mill Village, N.S.

RCA sought an extension to the development project which would allow them to develop a complete line of component parts which could be adapted to various system configurations. It was considered that the "off-the-shelf" technology would put the company in the best position possible to respond quickly to any requirements for satellite communications equipment.

The Defence Industry Productivity Program investment in this project was \$1,450,000 and to March 1974 the company has reported sales of \$80 million.

11.4 CAE Industries Aircraft Flight Simulators

Until the early 1960's CAE developed simulators primarily to meet Canadian defence requirements. With the development of advanced commercial jet aircraft it became evident that commercial simulators would use digital computers and that military simulator requirements would follow the pattern.

In 1964 the DIP Program gave assistance to CAE to develop a digital flight simulator for the DC-8 aircraft. This assistance was given in order to ensure that CAE maintained its ability to respond to future military and commercial requirements for simulators.

Since 1964 the company has been supported in the development of several flight simulators including a simulator for Boeing 747, 737, the Lockheed 1011 and the DC-10. At present the CAE is working on a simulator for the UHID helicopter and the 727-200 aircraft.

Sales to March 1974 for all simulators total \$38 million for a Crown investment of approximately \$4 million.

11.5 AN/USD - 501 (CL-89) Surveillance Drone System Canadair Limited

In 1964 Canadair Limited undertook the development of a sophisticated, passive, short range battlefield surveillance system. This project was cost-shared between the Governments of Canada, the United Kingdom and the Federal Republic of Germany. The successful development was followed by production of the equipment in 1969, and is now the only operational battlefield surveillance system in service. Sales have been made to the Federal Republic of Germany, the United Kingdom and Italy.

A Crown investment of approximately \$12 million has resulted in total sales of \$140 million with further sales prospects estimated at \$50 million now being considered.

11.5 (Cont'd.)

This project has established Canadair as a world leader in battlefield surveillance systems and have brought about two new surveillance systems development projects which are being undertaken by the company with further Crown assistance.

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FIRST SESSION—THIRTIETH PARLIAMENT
1974-75-76

THE SENATE OF CANADA
PROCEEDINGS OF THE
SPECIAL COMMITTEE OF THE SENATE ON
SCIENCE POLICY

The Honourable MAURICE LAMONTAGNE, P.C., *Chairman*

Issue No. 7

WEDNESDAY, MARCH 24, 1976

Seventh Proceedings on:
The Study of Canadian Government and
other expenditures on scientific activities
and matters related thereto.

(Witnesses: See Minutes of Proceedings)



THE SPECIAL COMMITTEE OF THE
SENATE ON SCIENCE POLICY

The Honourable Maurice Lamontagne, P.C.,
Chairman

The Honourable Donald Cameron, *Deputy Chairman*

and

The Honourable Senators:

Asselin	Hastings
Bélisle	Hicks
Bell	Lang
Blois	Manning
Bonnell	Neiman
Bourget	Riel
Buckwold	Robichaud
Carter	Rowe
Giguère	Stanbury
Godfrey	Thompson
Goldenberg	van Roggen
Grosart	Yuzyk—(27)
Haig	

27 Members

(Quorum 5)

Order of Reference

Extract from the First Report of the Special Committee of the Senate on Science Policy, presented on July 10, 1975 and printed as an Appendix to the Minutes of the Proceedings of the Senate of that day, and adopted by the Senate on July 24, 1975:

"The Committee, therefore, recommends that it be authorized to consider and report on Canadian government and other expenditures on scientific activities and matters related thereto;

That the Committee have power to engage the services of such counsel and clerical personnel as may be necessary for the purpose of the inquiry;

That the Committee have power to send for persons, papers and records, to sit during adjournments of the Senate and to report from time to time; and

That the Committee be authorized to print such papers and evidence from day to day as may be ordered by the Committee."

Robert Fortier,
Clerk of the Senate.

Minutes of Proceedings

Wednesday, March 24, 1976

(16)

Pursuant to adjournment and notice the Special Committee of the Senate on Science Policy met this day at 3:40 p.m., the Chairman, the Honourable Senator Lamontagne, presiding.

Present: The Honourable Senators Bell, Bonnell, Bourget, Cameron, Carter, Godfrey, Grosart, Lamontagne, Manning, Neiman and Rowe. (11)

In attendance: Messrs. Philip J. Pocock, Director of Research, and Jacques W. Ostiguy, Chief of Administration.

The Committee proceeded to the consideration of its Order of Reference dated July 24, 1975 relating to the study of Canadian Government and other expenditures on scientific activities and matters related thereto.

The following witnesses from the *Department of Industry, Trade and Commerce* were heard:

Mr. Lubor F. Drahotsky,
Assistant Deputy Minister,
Industrial Policies;

Dr. Sydney Wagner,
General Director,
Office of Science and Technology;

Mr. W. R. Graham,
Acting Director,
Program Office,
Finance and Programs.

Mr. Drahotsky made an opening statement. The witnesses then answered questions put to them by members of the Committee.

At 5:15 p.m. the Committee adjourned until 3:30 p.m., Wednesday, March 31, 1976.

ATTEST:

Patrick J. Savoie,
Clerk of the Committee.

The Standing Senate Committee on Science Policy

Evidence

Ottawa, Wednesday, March 24, 1976

The Special Committee of the Senate on Science Policy met this day at 3.30 p.m. to consider Canadian Government and other expenditures on scientific activities and matters relating thereto.

Senator Maurice Lamontagne (*Chairman*) in the Chair.

The Chairman: Honourable senators, I think our guests this afternoon would like to make a brief statement in response to the questions left pending last week.

Mr. Lubor F. Drahotsky, Assistant Deputy Minister, Industrial Policies, Department of Industry, Trade and Commerce: Thank you very much, Mr. Chairman.

Honourable senators, at the end of the last meeting you asked me in the first place to state the department's approach to influencing the activities of the private sector of Canadian industry; and, secondly, in response to Senator Carter's request, to describe the trigger and the rationale for a sector policy initiative, using the shipbuilding industry as an example. I would like to deal with those two points, if I may, in my introductory remarks.

I am sure you will realize that in responding to these questions I am in fact interpreting government policy. Such an interpretation cannot but reflect, to a considerable extent, subjective judgment. I am, of course, in no way qualified to give you a firm and binding statement of government policy, either as regards the past or as regards the future; but if you will accept these qualifications, I am prepared to give you what cannot but be a highly subjective effort to answer the questions you raised.

Firstly, I would like to repeat that with a few significant exceptions the department has tended to rely on the private decision-making process to identify the opportunities that exist for improving the performance of Canadian industry. To put it differently, up to now the government appears to have interpreted its role as being essentially one of creating an environment within which the private decision-making process will function, and to intervene only in those cases in which, for one reason or another, the private decision-making process does not yield results which are considered to be consistent with the public interest. There are, of course, many examples of direct government intervention in the private decision-making process, some of which were mentioned here last week. They include, for example, such areas as transportation, agriculture, housing, atomic energy, communications and others.

It is noteworthy, I think, that in all of these cases, as well as in others, the responsibility for the required degree of government intervention has usually been assigned to a separate, mission-oriented department, and there are individual departments which have a responsibility for

these various areas. I am thinking of the Department of Agriculture, the Ministry of State for Urban Affairs, the Department of Communications, the Ministry of Transport, and others.

As far as the Department of Industry, Trade and Commerce is concerned, we have a broad mandate to promote efficiency and international competitiveness in Canadian industry generally, through a variety of instruments, of which technological innovations is but one. In doing so, we have taken the view that bureaucratic judgment is a poor substitute for private entrepreneurship. We have interpreted our role to be primarily one of assisting industry in identifying opportunities, and of providing support when it is needed in order to capitalize on opportunities or to overcome constraints.

In some instances, as you well know, we have gone a long way in providing encouragement and direct financial assistance for the exploiting of specific technological opportunities, such as, for example, those of the new generation of medium sized computers—business computers—developed by Control Data Corporation; the integrated circuits project of Microsystems; the new generation of gas turbine engines of United Aircraft; and the air cooled diesel engines for truck application of Deutz Diesel. In all of these cases, the department has assisted in the identification, assessment and exploitation of the particular opportunity. Some of these projects have turned out to be quite successful; others, as is well known, have failed. This indicated how difficult it is to make the critical judgment of viability of a particular technological breakthrough, even when government and industry join forces to do so.

Let me now turn to shipbuilding policy as an example of a sector strategy. It illustrates, I think very well, how the opportunities and constraints which a particular industry sector faces may change very rapidly within a relatively short period of time, with profound implications for the industry's performance. The rapidly changing nature of the domestic and of the external environment constitute the major challenge that all would-be planners must face. Moreover, as honourable senators know, the rate of change appears to be accelerating.

Turning now to the shipbuilding strategy in order to trace the rationale for, one has to go back to the 1950s. It was during the 1950s that the first need for direct intervention emerged. At that time the government was providing about 30 per cent of the total market for the shipbuilding sector, principally in terms of destroyer escorts, minesweepers and other military craft. Contracts at that time were distributed to the shipyards on an allocation basis, and were based on the principle of cost reimbursement rather than competitive pricing. As a result, the industry developed considerable skills in the building of ships; however, it failed to develop a significant competitive advantage or capability.

In the early 1960s, with the opening of the St. Lawrence Seaway, there was an increased domestic demand for commercial vessels. To ensure that this demand was channelled to Canadian yards, the government introduced a shipbuilding subsidy of 40 per cent, applicable to commercial ships built in Canadian yards for Canadian operations. The output of the yards increased; however, since the subsidy protected the yards from foreign competition there appeared to be no significant improvement in its competitive performance.

In 1965 the subsidy approach was modified, and the subsidy was gradually dropped from a level of 40 per cent to one of 17 per cent, the rationale behind this being that in order to stimulate competition in the industry it was desirable to reduce the artificial levels of protection to roughly the same levels as applied to other industry sectors. At the same time the government procurement approach was radically changed from the one that I described earlier, based on cost reimbursement, to one based on competitive pricing and a firm contract price.

In the 1970s there suddenly developed a very buoyant international market for ships. In order to exploit this sudden external demand, the government introduced a new program which provides for payment of up to 17 per cent of the cost of vessels built in Canada for export. The program produced since its inception in 1970 almost a billion dollars' worth of export contracts, shipyards substantially revamped their methods of operation, and they have engaged in multi-unit production. They have now developed a recognized competence in international markets.

Finally, in March last year the two subsidy programs, the one for the domestic market and the one for the external markets, were replaced by one program. This splits the grant into two components, one of 3 per cent available as a matching contribution towards shipyard modernization—that is where the government matches the industry expenditure—and a 14 per cent outright subsidy designed to decline by 1 percentage point each year until a maximum of 8 per cent is reached in 1981. It is too early at this stage to say what the net results of that approach are likely to be.

Mr. Chairman, I think it is interesting to note the shift in focus that I have described from government procurement to domestic commercial markets and, finally, to international markets. I understand that at each phase in the process of this almost continuous strategy development, industry participated in the definition of the problem and the identification of the options open to deal with the problem. This does not automatically mean that industry in each and every case agreed with the approach. For example, during the 1965 changes, I believe, they expressed considerable concern as to whether or not this was in fact the right approach.

Mr. Chairman, I am not sure whether I have given you the answers you wanted, but I can assure you that the answers I have given are factually correct to the best of my knowledge. Of course, once again, they do involve a large element of subjective judgment.

The Chairman: I think we should not spend too much time on shipbuilding, but since Senator Carter raised the subject at our last meeting and since he apparently wants to ask a question relating to that, I will allow a couple of questions.

Senator Carter: Mr. Chairman, I do not want to pursue at great length the commentary which the witness has given. I appreciate the difficulty under which he is labouring in having to deal with policy decisions, but if I understand him correctly, he said it was the policy or the procedure of the department to let the private sector do the decision making. Is that a fair interpretation of what you said, Mr. Drahotsky?

Mr. Drahotsky: I am afraid, senator, I could not go as far as that; that is, if you mean that by allowing the private sector to participate in the decision-making process, they become party to the final policy decision. In most instances I would be inclined to say that the answer is no; they are consulted at the stage when the need for a policy initiative appears, and they are consulted and their views are taken into account in analyzing the situation with the hope of arriving at an agreed assessment of what the problem or the need is. They are consulted in the process of identifying the options available to deal with a problem. But the final decision on the nature of the policy initiative, of course, belongs to the government.

Senator Carter: When I asked the question, my mind was working along totally different lines from the answer I received. Somebody has said that one of the best ways to describe science policy—and science policy is what we are interested in here—is as research, R&D and innovation, and this is the meat of this committee, and one of the best ways of looking at science policy is in terms of problems being solved. So I would ask what problems are being solved or what problems you are wrestling with. Who decides what these problems are? That is the point I wanted to get to. I realize that the shipbuilding industry is a special case because it is a vital industry, essential to our national security, and however inefficient it may be we cannot let it die; we simply have to keep it alive. So if we can find a way of exploiting it and getting it working for the benefit of the domestic market, so much the better. But that is not the meat of what I am interested in. I am interested in what problems in the shipbuilding industry we are wrestling with and who decides on the problems.

Mr. Drahotsky: If I may generalize the question, Mr. Chairman, and move away somewhat from the shipbuilding industry and talk in general terms of policy formulation, there is a variety of ways in which a problem that many require a policy response is identified: sometimes it is identified by the industry concerned; sometimes it may be identified at the ministerial level; and in some cases it may be identified in the process of our analysis of the performance of various sectors. So the process may be triggered off in a variety of ways, and it may be in the private domain or in the government domain or in the political domain, as quite often is the case. How one then responds to a particular problem or opportunity varies greatly depending on the nature of the particular issue, to what extent it is characteristic of a sector of industry, or whether it represents an issue or an opportunity for one particular firm. Then there is the consideration of what the mechanics available are, whether the industry is organized or whether, as quite often happens, it is largely dominated by one firm which, to a large extent, influences the performance of that particular sector. So the way that the responses are developed will vary from one case to another.

Senator Carter: Could I just mention one other problem?

The Chairman: Just one.

Senator Carter: We have a problem with shipping due to high cost and a shortage of energy. Because of that, a great deal of research has been going on into the use of wind energy for ships—almost going back to the old sailing days—so my question is this: Are we doing anything on that? Are we up to date on what is being done in other places? Just where do we fit in in this type of problem? Are we doing anything about it at all? Are we interested in it? Is MOSST interested in it? Is anyone interested in it?

Mr. Drahotsky: If it is a question of basic research, to come up with new ways of utilizing wind power as a source of energy, I am aware that this was one of the areas identified by the task force on energy R&D which is orchestrated, if I may use that term, by the Department of Energy, Mines and Resources. I am not positive, but I would imagine that NRC would be involved in that particular area. My department does not as a rule either directly engage or directly contribute to basic research.

Senator Godfrey: I just cannot resist the comment that the shipbuilding industry seems to be one sector of our economy in which a pure free market system does not seem to have been working to perfection.

Mr. Drahotsky: That is also so throughout the world. It is not the only sector of our economy which finds itself in that position.

Senator Godfrey: It is an obvious example.

The Chairman: To return to your original statement, you said that you have a passive attitude toward the problems that industry is bringing to your attention for assistance. This means, of course, that you do not have any great or specific system of priorities. That answers, I believe, some of the questions which were raised last week. However, the other aspect was the assessment of the results of your program. You may not have priorities, or you may adopt a passive attitude, but surely you are in a position to assess the results as to whether these grants are a good investment in terms of producing new technology, for instance. I do not believe you dealt with this in your opening statement.

Mr. Drahotsky: Yes, Mr. Chairman; perhaps I should endeavour to sum up what admittedly was a rather disjointed response given at the last meeting. I would be inclined to put it this way: We, indeed, look at the performance of our individual programs in the context of their narrow objectives. The evaluation that is carried out is in terms of looking at individual projects, the extent to which our support has led to commercialization, as anticipated, or the extent to which there may have been failures. We have also looked at and are in a position to give you a generalized view of the results of the IRDIA program which, I must say, is not that different from the assessment that Mr. Drury placed before you when he was appearing before this committee. That is, that by and large the IRDIA program has not generated the level of activity in Canadian industry which it was originally expected it would generate. There are a number of reasons why this has happened and I would be glad to go into those.

The Chairman: We will come to that when we consider the specific reference to IRDIA in your brief. Are there any other questions with respect to the general aspects?

Senator Grosart: Mr. Chairman, it seems to me that we are not going to get anywhere until we receive some answers to the major questions in this whole area of the relationship of R&D and industrial innovation to our broad economic problems. I do not know whether the assistant deputy minister is the person of whom we should ask this question, but are we satisfied with the situation in which: firstly all or most of the government programs intended to assist industry have failed—and apparently we have that admission; secondly, our percentage gross expenditure on R&D in Canada is declining, when in some of the countries with which we are competing it is generally increasing; thirdly, on the evidence, our percentage of manpower engaged in R&D and innovation in industry is unbelievably lower than that of comparable countries.

There are some figures here, for example, that R&D manpower engaged in industry, on the average, in France, West Germany, Japan, The Netherlands and Sweden is 25.8 per 10,000 population and in Canada it is 8.5. The comparable figure is that the percentage of R&D manpower in universities is approximately the same. However, of course, when we come to the total manpower we are not much more than half.

Again I come back to it, and I am sorry to have to do it, but we had, five, six or seven years ago, a statement that it was high government priority to shift funding into industry, and all the evidence is that it has not happened. Does anyone care that this is the situation? Is it wrong? Are we satisfied? Do we intend to continue with the present trend of the funding of R&D in industry decreasing? If not, do we intend to reverse it? And, if so, how? I ask these questions because I read in the department's brief that there is to be a "new industrial development policy." It then lists the policy proposals, none of which shows much concern with respect to these matters and none of which states that we really are going to reverse some of these trends; but we intend to. It winds up by telling us that "in response to the Cabinet's instructions the first thing we have done is set up an interdepartmental committee on industry policies and strategies."

I do not intend to bother asking many more questions until I get an answer as to whether this is going on. If it is, we might as well wash up the committee and say there is nothing we can do if there is no strategy policy, intent, will on the part of the government to do something about this falling level of GERD and FERD and every other aspect of the potential of Canadian productivity and its position in the export markets being improved from the present situation. That is the question I asked and I cannot get an answer. I do not know why.

The Chairman: Will you give an answer, Mr. Drahotsky?

Mr. Drahotsky: I will make every effort to do so, Mr. Chairman. I believe Senator Grosart really raised three fundamental questions. The first is: Are we satisfied with the innovative performance of Canadian industry? And the answer is—I am again replying as a government official—that we obviously are not satisfied and most likely will never be satisfied. It would be, in my view, disastrous if we were satisfied.

Senator Grosart: Some countries that are satisfied are doing very well.

Mr. Drahotsky: Perhaps I shall deal with that statement next. My figures show, looking at OECD countries and using the standard measure of gross expenditures on

R&D in relation to GNP, that among the 10 industrialized members of OECD the ratio of GERD to GNP varies from 1.2 per cent for Belgium and Canada to 2.6 per cent for the United States.

Senator Grosart: So we are at the bottom of the list?

Mr. Drachotsky: In that comparison we are at the bottom of the list and on about the same footing as Belgium.

Senator Grosart: And Ireland.

The Chairman: It is a little lower in Ireland.

Mr. Drachotsky: Interestingly the figure for Japan is 1.6, as it is for Sweden; so we are by 0.4 percentage points worse off than Japan and Sweden.

With respect to the decline that has been occurring in innovative performance over the past four or five years, I would like to draw the attention of the committee to a very interesting article in *Business Week* of February 16, entitled "The Breakdown of U.S. Innovation," where the statement is made that real spending by industry—that is, in real terms—for basic research has slipped by 12 per cent and that federal funding for research within industry over the past 10 years fell by 45 per cent. The article tries to indicate some of the possible reasons why the rate of innovation in the most innovative of all industries in the world is falling so drastically.

Senator Rowe: Is that in the United States?

Mr. Drachotsky: Yes.

Senator Rowe: Would that decline be the result of curtailment of their space program?

Mr. Drachotsky: From the way the article reads, I believe the impact of defence spending has been taken out of these figures. In any event, it is not mentioned here as the main reason for the decline in innovative activity.

The Chairman: In any case, I put on the record a couple of weeks ago the fact that the United States intended to increase its expenditures by 11 per cent this year, in 1976, so perhaps the trend toward decline in recent years will go up and will follow the trend of the 1960s, at least in 1976.

Mr. Drachotsky: If I might broaden this comparison, in the July-August 1975 issue of the *OECD Observer* there is a very comprehensive article on R&D trends in the OECD area since 1971. Some of the findings of that particular analysis are that in Canada, France, the United Kingdom and the United States, national R&D potential continues to decline. The share of GNP devoted to R&D is falling. In the Netherlands and Iceland the real growth of GERD is well below 5 per cent, and there is a detailed analysis, and detailed tables, not only on trends in R&D expenditures—which, with a few exceptions, are drastically downward in all OECD countries—but also on the respective share of R&D expenditure as between government, private enterprise and foreign sources.

Looking at that analysis, I cannot say that our performance, in relative terms, compares that badly. But, again, that is not to say that we ought to be satisfied with that performance. It is obvious that over the past four years, in any event, the total economic climate in Canada, in the OECD countries and internationally, has not been very conducive to expenditures on innovative activity, which, as the committee is aware, is an area which traditionally gets hit when industry is facing up to tough competitive

pressures, when profits are declining and when managements have to tighten their belts and make pretty tough decisions on how to allocate their overall expenditures.

I believe it is a matter of historical record that that is where the first cuts normally come, in expenditures devoted to research and development.

I cannot comment on the usefulness and validity of the use of scientific manpower figures as a basis for assessing the relative innovative performance of various countries, because obviously there will be a wide variation in this particular element, depending on the extent to which a particular country relies entirely or exclusively on native research, indigenous research, or the extent it relies on imports of technology, as Canada has traditionally been doing for the reasons I believe we discussed briefly at the last meeting.

The Chairman: We do not import only technology; we import products.

Senator Grosart: Yes. Not much technology either. But this does not alter the basic question, which is that the federal percentage of funding in industry is declining in spite of continual statements that it was government policy to increase it. That is the point I come back to. What is the answer? Has it been impossible for the government to get this policy implemented? Is it the intention not to care whether or not it happens? I am talking about a statement of the Canadian government—a statement which has been made repeatedly. Yet, we have this decline and no one will say why.

Senator Godfrey: That is not being fair to the witness. He just gave what I thought was one very good explanation, that being that we had a recession for four years.

Senator Grosart: I do not want to argue, but the recession had nothing to do with the transfer of the money from one performance sector to another. It does not matter if it is \$10, \$100 or \$10,000; it has nothing to do with it.

Senator Godfrey: You are making general statements. I think I should comment, Mr. Chairman, because Senator Grosart just made a sweeping statement, that I know of a very large company which was looking at another company which was in financial difficulty and decided that if it bought that company it could put it in the black in three months simply by eliminating all research and development, all engineering, and contract in the United States at a very small fraction of that company's current costs in that connection. The government cannot be blamed for that kind of attitude; it cannot be blamed because a company decides to get the same kind of thing in the United States for a fraction of the cost.

Senator Grosart: I am not talking about industry's decisions at all. I am talking only about the decision of the federal government to implement its own stated policy to transfer more of its own funding into industry so that we will not continue to be at the very bottom of the ladder in that respect. On a comparative basis, probably less than half the percentage of government funding—and I want to make it clear that I am talking only about government funding—is devoted to industry in Canada compared with many other countries.

Senator Godfrey: But how do you jam it down industry's throat?

Senator Grosart: Perhaps the witness can give us an answer.

The Chairman: Perhaps this should be pursued on the floor of the Senate.

Senator Godfrey: If Senator Grosart is going to give a few speeches, I would like to give one, too.

Senator Grosart: I am simply asking questions, and they are not political questions.

Senator Godfrey: I know that. This has nothing to do with politics.

Senator Grosart: This is the first time we have had this kind of reaction in the committee.

Senator Godfrey: I was not even thinking of politics.

Senator Grosart: Perhaps the witness could answer the question.

Mr. Drahotsky: Unfortunately, I cannot answer your question, Senator Grosart, with respect to total federal government R&D activity. I do not have those figures, nor is it within my competence to comment on the global performance. If I may, I should like to answer the question in the context of the expenditures for which the Department of Industry, Trade and Commerce has primary responsibility.

If you add up our four technology-oriented programs, IRDIA, DIP, PAIT, and IRAP which is administered by the National Research Council, my figures show that, in terms of expenditures under those four programs, expenditures increased without interruption until 1973-74, when they reached a total of \$112 million.

It would really be inconsequential to mention the level from which those programs started, because they were new programs. For that reason, any percentage comparisons would be ridiculous. The fact is, there was steady growth in program expenditures up to and including 1973-74, at which time they accounted for 20 per cent of total industrial R&D. In 1974-75 there was a decline to a level of just over \$100 million, and a corresponding decline in the percentage of total industrial R&D represented by those expenditures. That percentage declined to 16 per cent.

Senator Grosart: We are talking about \$100 million out of \$1.3 billion?

Mr. Drahotsky: Yes, senator.

The Chairman: Do you turn down many requests from industry?

Mr. Drahotsky: To answer your question properly, Mr. Chairman, I would have to backtrack. Because of the manner in which requests are brought forward through our system, the answer to your question could not be taken as representative. Most of the requests that come before the approval committees have been developed with the firms concerned. The requests are taken from the concept to the final application for support. In that sense, I would imagine that the rejections are indeed few. The reason for that is the way in which the applicant is almost taken by the hand and assisted at each and every step in formulating the proposal and in placing it before the approval committee.

Senator Grosart: With respect to the new industrial development policy which is referred to on page 7 of the

brief submitted by the department to the committee, how will this differ from the old policy, and why the differences? Why are they necessary and what will they accomplish?

Mr. Drahotsky: I suppose the essential difference would be one of using an essentially ad hoc reactive approach to the identification of problem areas, or opportunities, as compared to a systematic approach. That would be the essential difference. Our sector branches have now embarked on a systematic assessment of the opportunities and constraints which individual sectors of Canadian industry face, with the view to identifying what action, whether in the area of market development, technology, management, financing, or restructuring, may be required to assist those sectors in maximizing their potential.

Senator Grosart: Would this include sending teams abroad to discover technology that may have an application in Canada, to assess markets, to assess present Canadian shares of markets—whether they be shipbuilding, or anything else—and to come up with a deliberate policy to improve Canadian performance in these areas?

Mr. Drahotsky: That is, indeed, part of the process which is already well under way. I believe there was just recently a pulp and paper mission to one of the Common Market countries, and there was a sizable mission to Japan relating to housing and wood products. As I say, this is a process that is well under way. I believe the only limitation on it is the limitation imposed by available resources, financial and manpower.

Senator Grosart: We have heard about these missions for years. Are you speaking of the type of mission we have had when the minister goes over with a group of parliamentarians, or a group from industry, or is this a technological manpower mission? I am thinking of what the Japanese did. Is this a group of scientists of various kinds—using "science" in the broadest sense—going over and really searching for markets and innovative concepts? I am thinking of it from the point of view of the department.

Mr. Drahotsky: I would imagine when we do participate in science and technology missions, of which we have had a number, including some to Japan, Germany and Belgium, the purpose of those missions is to identify the scope that exists for information exchanges, the sharing of technology or new joint projects, technology-oriented projects. That is one kind of a mission. We also have what might be described perhaps as more pedestrian missions, which zero in on a particular commodity, such as lumber, and in a way try to define the scope that exists for exports, for the sale of those products, or for joint ventures relating to the manufacture of those products, or the exchange of technology and know-how. I would be inclined to say that, in my experience at least, no two missions are the same. It depends on what the thrust is, what country is being visited.

In many instances, especially lately, we have been inviting participation from the private sector on those missions with the idea that in many countries, including Japan, for example, governments' presence is highly desirable at the initial stages, but then it is up to the private industry to carry on and reap the benefits of this government umbrella. You may recall that about two years ago Mr. Pepin led a very substantial mission to Japan, and I believe we are still reaping the benefits of that effort.

Senator Grosart: How many are at work around the world right now?

Mr. Drahotsky: I am sorry, I cannot answer that.

Senator Grosart: Is anybody at work today around the world? The Japanese for many years had 23 missions continuously on the go around the world.

Mr. Drahotsky: All I can say is that Mr. Jamieson, as you know, has just returned from an extensive tour of Southeast Asia. I believe he will shortly be leaving for Western Europe. He has already visited France and Switzerland, which was shortly after he accepted his new portfolio, and that was strictly a selling mission, a hard selling mission. I am sorry, but I cannot say how many missions we have in the field at the present time. I could get the information.

Senator Grosart: Without throwing any aspersions on the usefulness of ministerial missions, this is not really what I am asking about. I am asking: do we have groups of technologists going around the world trying to see what we can do about upgrading our position in the most important markets in the world today, which is scientific innovation? I am not saying we should. I am merely asking whether this is the technique, or whether it is part of this new industrial development policy.

Mr. Drahotsky: An important element of the industrial development policy, which is an element arising directly out of the new approach, is what we call the industrial co-operation approach, which at this moment we are aiming, with the exception of Japan, almost exclusively at the members of the European Economic Community. Just before Christmas my colleague, the assistant deputy minister responsible for industrial development, visited I believe at least half a dozen Western European countries to identify the opportunities that exist for technological exchanges, joint ventures, joint ventures in third countries, licensing agreements. The results of the first contacts of that kind are being assessed at the present time, and there will be a follow-up planned for the spring. I suppose the answer is that we do not have people continuously circling the globe in search of opportunities all over the world. I believe it would be right to say that we use the rifle approach rather than the shotgun approach at this time.

The Chairman: It seems to me, Senator Grosart, that you are now questioning our witnesses on specific areas of the brief, especially in reference to that section of the brief. I still have a few general questions to ask, going back to our main concern, and I would like to pose them before we start dealing with specifics.

I understand that the department's industrial mission, as opposed to its trade mission, is to help Canadian manufacturing mainly, and in particular to assist that sector of the Canadian economy in attaining the best possible level of innovative performance. Am I right in making that statement?

Mr. Drahotsky: Among other things. Concern for innovative performance is one element of the effort.

The Chairman: If we start from there, in my view the various measures specifically designed to improve industry's innovative performance fall into four broad categories: fiscal incentives, government in-house R&D and other scientific activities, contracting out or the "make or buy" policy, and other services—the last category, other

services, including scientific and technical information which helps to provide patterns and so on. Do you think these four categories more or less cover the whole area of possible government assistance to improve the innovative capacity of Canadian industry?

Mr. Drahotsky: I would add to your list, Mr. Chairman, if I may, the process of opportunity identification, which I would separate from the "transfer of information" element that you have mentioned.

The Chairman: We could include this in the residual category which I identified as "services."

Mr. Drahotsky: Which, to me, is a very important element.

The Chairman: Let us say for the time being that these four categories are more or less adequate to cover the area. There are at the moment three incentive programs left, DIP, PAIT and IRAP. Out of these three programs, is it not true that your department is responsible for only two?

Mr. Drahotsky: That is right.

The Chairman: Therefore, in that area you control only two-thirds of the programs which are available in terms of fiscal incentives to industries. To go to another category of assistance, is it true to say that ITC has no responsibility whatsoever with regard to government labs, not even those whose mission it is to serve manufacturing industries?

Mr. Drahotsky: That is so at the present time.

The Chairman: Is your department involved in the actual implementation of the "make or buy" policy, which is another category?

Mr. Drahotsky: It is my information that we were very intimately involved in the formulation of the "make or buy" policy.

The Chairman: But not in its implementation?

Mr. Drahotsky: We are not directly involved in its implementation, although I understand we are frequently consulted on specific projects.

The Chairman: Coming to the last category in my series of questions, is ITC involved in the actual operation of the Canadian Institute for Scientific and Technical Information?

Mr. Drahotsky: I will ask Dr. Wagner to deal with that question.

Dr. Sydney Wagner, General Director, Office of Science and Technology, Department of Industry, Trade and Commerce: Mr. Chairman, we are not involved in an operating role in the Canadian Institute for Scientific and Technical Information. On the other hand, I believe the committee should be aware that there is an advisory board on scientific and technical information, and I am a member of that board.

The Chairman: As far as I can see, among the four categories I have identified, to assist industry in improving its innovative performance, you have no direct responsibility, as a department, in three of these categories and you have only direct responsibility for two of the three fiscal incentive programs. So, under those conditions how

can you accomplish successfully and efficiently your mission?

Mr. Drahotsky: The mission being?

The Chairman: In particular, to help improve the innovative performance of industry.

Mr. Drahotsky: The mission being to assist Canadian industry in improving its competitive performance?

The Chairman: And its innovative performance, because we are still talking about increasing industry's share in R & D, leading to possible innovation.

Mr. Drahotsky: Well, that is, indeed, a highly relevant and complicated question. I believe I have already indicated that so far we have not faced the situation where we have exhausted the funding available to us for our innovative technology oriented programs. To that extent one could conclude, inasmuch as there is scope for improving innovative performance in Canadian industry, through the instruments available to us, and to the extent that Canadian industry has availed itself of instruments available to us, that we have not failed in our mission.

Now, it may well be that other more powerful instruments are needed to stimulate a higher level of innovative activity in Canadian industry, and I am sure most of us will agree that that is so, and that other more powerful instruments are, in fact, available. I do not think I am in a position to comment on why the government prefers to use one policy instrument to promote innovation rather than another.

The Chairman: The government as a whole is using all these various approaches that I have described, but they are not under the direct responsibility of the department which has the mission, it seems to me. Perhaps I should not put that question to you but rather to the minister.

Senator Bell: It is rather fundamental, Mr. Chairman.

The Chairman: It seems to me that it is rather fundamental, because if you give a mission to a department and you do not give the instruments to achieve that mission, it is not too surprising that the mission is not accomplished.

That completes the series of questions I had.

Senator Godfrey: I should tell you at the beginning that I am not too familiar with these programs and I should explain also that I was not originally on the Senate's Science Policy Committee and, therefore, I do not speak with the same authority and I have not the same dedication to the first report as some of the other members.

Now, having said that, in terms of the grants, could you give us some idea, with reference to the percentages of grants that are given for research and development, as to how many companies benefit by them? In other words, dealing with the top ten companies or top fifty companies that get the most, what would their percentage be of the total grants? I have the impression that these are concentrated in a few large companies. Am I right or wrong?

Mr. Drahotsky: If I may, Mr. Chairman, I would invite Mr. Graham, who is the acting director of the program office in the department to throw some light on this statistical question, if he can.

Mr. W. R. Graham, Acting Director, Program Office, Finance and Programs, Department of Industry, Trade

and Commerce: It is true that the grants are, in the R&D area, heavily concentrated in the larger companies. Of course, they are the ones that are capable of undertaking the larger projects and therefore I believe that is reasonable. By way of statistics, the twenty largest companies have approximately 40 per cent of the total R&D money. That is an approximation, but it is in that area.

Senator Cameron: What would the total number of companies receiving R&D money be?

Mr. Graham: Under the earlier program, which has just finished, there were 3,000 companies in total that had taken advantage of that program. In the case of the PAIT program, which is continuing, we have had now some 900 companies which have taken advantage of that program.

Senator Carter: Can you give a figure in terms of dollars, with reference to these 3,000 companies, or a percentage of the total grants? How much do they receive?

Mr. Graham: Excuse me; I am not sure that I understand you.

Senator Grosart: What is the average?

Mr. Graham: The average grant is approximately \$150,000 across the whole spectrum of the program.

Senator Carter: That is only for the one program, the IRDIA program?

Mr. Graham: No, that applies more directly to the PAIT program. Under the IRDIA program, the average would be considerably less—I am estimating here—and it would perhaps be somewhere in the \$40,000 range.

Senator Godfrey: With reference to these top 20 companies that get 40 per cent, what kind of money are we talking about? What does that 40 per cent translate into, when we talk of dollars and cents?

Mr. Drahotsky: Perhaps I can deal with that question by giving you a general overview of the order of magnitude. Under the PAIT program since its inception in 1965-66 up to and including fiscal 1974-75 total expenditures have come to about \$140 million and have involved some 865 projects.

Senator Godfrey: That is just projects, not different companies.

Mr. Drahotsky: Projects, yes. That should provide you with an overall idea.

Mr. Graham: Could you put your question in context again, senator?

Senator Godfrey: I just want to know what the total figure is so that we can have some idea of how much money these 20 companies have received in total. You have mentioned a figure of \$140 million.

Mr. Drahotsky: Mr. Chairman, while Mr. Graham is looking for the IRDIA figure, I will give you the DIP figure on the same basis. Since the inception of the program in fiscal 1959-60 up to and including fiscal 1974-75, the total expenditures have amounted to \$475 million and have involved some 730 individual projects.

Mr. Graham: In terms of IRDIA, the 961 applications have produced grants authorized of \$26 million.

Senator Carter: Do you mean applications approved or simply applications?

Mr. Graham: It is applications approved, senator.

Senator Grosart: Mr. Chairman, the obvious question, to me, is: Is the problem here the incapacity of some sectors of Canadian industry to absorb grants of no more than, say, an average of \$150,000 a piece? Is this part of the problem?

Mr. Drahotsky: Mr. Chairman, I believe there is no neat, simple answer to the question why, at first sight, we appear to be incapable of generating a greater degree of utilization of our programs.

The Chairman: But do you go and seek customers, with your passive attitude?

Mr. Drahotsky: Could I ask Dr. Wagner, who is more familiar with how the programs work, to see if he can throw some light on this?

Dr. Wagner: There really are a couple of aspects, Mr. Chairman and senators, that one should keep in mind. In the first case I think there is in fact some lack of ability on the part of many Canadian companies to absorb more than a certain number of funds. For example, take the case of many small companies or medium-size companies coming in for the first time, or just the second time, one of our greatest concerns is to make sure, first, that the project they want to develop is a viable one from a technological point of view; second, that it is likely to make some money for them somewhere down the road; and, third, to ensure that they know how to manage that particular project once they have it inside. In fact, our examination of the results of projects shows that most projects do not fail for technological reasons; most projects, in fact, do not even fail for financial reasons of whatever sort. They fail because companies, for whatever reason, are unable to manage the projects. Either they misjudge the market or they misjudge the cost.

Coming back to the reason that big companies take big projects, it is that they have the management ability to manage these big projects. They have the financial resources to take the risk, and, in fact, to a first approximation, although it may be a bit unfair to say this, the big companies spend the big money and take the least risks. The riskier projects usually are the smaller company projects.

The Chairman: And very likely the civil servant who has to approve or disapprove the project is more at ease when dealing with a big company, because it poses less risk for him as well.

Dr. Wagner: Well, I am a civil servant, but if I might take issue with you, Mr. Chairman, what I would like to assure you . . .

The Chairman: I was one, too!

Dr. Wagner: What I would like to assure you is that we are quite excited when we in fact see a small company taking a risky project. One of the things we are at pains to do is try to make sure that that company takes the steps it needs to take in order to be successful. One of the biggest problems that we have, in fact, with companies is convincing them to employ more competent people. A characteris-

tic of a small or medium-size company is that it has one person or just a few people in management. A characteristic of those people is that they tend to try to want to do everything themselves. It is extremely difficult to convince the president or the general manager in charge of production of the company that he really needs a good, high-quality engineer, and that he is going to have to pay a substantial sum of money for him, and that we would not even mind having that man's salary as part of the project. It is often still difficult to convince them to come in. So, in fact, we are looking at a situation in which we are trying to push as much technology into companies as we can. Even so we have in more years than I care to remember not spent all of the funds available to us.

Senator Godfrey: I am not a mathematician, I am just a simple lawyer, but I want to make sure I have drawn the right conclusions from what I have been told. It would appear to me, from the figures that you have given, that \$256 million has been divided among 20 companies under these programs, which, if my arithmetic is good, means \$12 $\frac{1}{2}$ million per company, which is not bad.

Dr. Wagner: That is not a particular figure, senator, that I have in my mind, but some of the larger companies are able to use some fairly substantial funds.

Mr. Graham: The figure of \$12 $\frac{1}{2}$ million is about right, senator.

Senator Grosart: What is the largest grant?

Dr. Wagner: Going a bit from memory, senator, it would be \$40 million, I guess. That would be the total contribution. I guess that is the largest one we are involved in right now.

Senator Grosart: What is the status of venture capital investment?

Dr. Wagner: It depends, senator.

Senator Grosart: You are talking about management, which is what venture capital normally supplies.

Dr. Wagner: I think, in talking about venture capital, first it depends on whom you talk to, and, second—and I think that I have now come to some sort of position on this—there does seem to be a genuine shortage of venture capital, provided you are not talking about starting a new company. People who have venture capital themselves, or who manage venture capital funds, simply do not want to be bothered with administering anything in the way of a start-up, for two reasons: one is that that is the riskiest part of the process; but, even more, rather than the risking of the money, is the time that this takes. Most venture capitalists have come to realize that to be successful—to make money—you have to have somebody on the management of the company who, if, for example, it is a question of putting a piece of technology together, can make dead sure that the technical man does not take over in an arbitrary way from the manager, or vice versa; that is, that the financial man does not so constrain the technical man that the project cannot be a success. The time spent in that kind of way is the time which is at the greatest premium, and it is one of the reasons why you find little or no money available between zero and \$250,000. I might say that the situation is not dissimilar in the United States.

Senator Godfrey: I must say that that is the experience I have had.

Senator Bell: Following on from that, suppose we want to infuse massive amounts of capital—risk capital, or whatever—into helping our industry do the things that we do best in this country—I assume that is the least risky thing to do—and there is only a certain amount of capital available, and you have government competing with a private industry that the Department of Industry, Trade and Commerce is trying to assist, is there some communication among the rest of the government departments, who are saying, “Hands off! We need some capital put into this segment of our more innovative type of development”? Is there any communication that will fit in with this type of thing?

Dr. Wagner: I have not quite got the thrust of that question.

Senator Bell: I think I have scooped too many things into this basket at once. We have been dealing with large problems, but take the small problem, where you have an industry that has a great technological future, it is off the drawing board, PAIT is assisting, and so on, but it must go out and raise private capital, too, in equal quantities, while you, at the other end of the country, have a fairly similar type of endeavour going on which has been taken over and is now a government enterprise. The capital is going to be a little bit drier for the riskier company, even though, with an objective evaluation, it perhaps would not be that way. In other words, if we have not had a great deal of enthusiastic acceptance of IRDIA's policies, is this because things are a little bit weighted—let us say that some things are more equal than others—if the government is backing them or is doing the developing, with all the in-house research and development funds?

Dr. Wagner: There may be two parts to that question, senator. I hope you are not putting forward the proposition that the government in fact buys up companies and then goes into competition with private companies. At least, if that happens, I am not aware that it happens to any great extent.

Senator Grosart: It has happened.

Dr. Wagner: Yes, but as a rule that is not the problem we are talking about. You are talking about in-house research versus research in industry, and the in-house people having certain advantages. Once again, on a first approximation, one must not exaggerate the in-house problem. Government departments, by and large, have laboratories to do their job. Now, I am the first one to believe that to the extent that it is possible, anything in a government laboratory which might be useful to industry should be got out to industry. I think more and more people believe that. More and more people are pushing that philosophy, of which the “make or buy” policy is one manifestation, and there are many other examples of that kind of thing; but by and large what is going on in a government laboratory is not industrially oriented, and if one wants to complain about, or wonder about, or be sad about, the division of dollars between government and industry, I for one do not think that the dollars are necessarily too high in government. One might share a little bit here and there, but by and large there is a job to be done, and I think the spin-off one can look for is marginal if thought about in terms of industry as a whole, and thought about particularly in terms of the manufacturing industry, when you put a \$25 billion figure on it. You can have some influence on that, but I do not think you can look for spin-off from

government laboratories for an important, massive input in there.

The Chairman: I certainly would question that, because, surely, there are quite a number of government labs whose essential mission is to help industry.

Dr. Wagner: I am talking on a proportional basis, Mr. Chairman.

The Chairman: I am talking about that, too. I will again use my favourite example. What has the forest products laboratory to do with the mission of the Department of the Environment?

Dr. Wagner: Well, without trying to answer that question, Mr. Chairman, the forest products laboratory is pretty modest in size when thought of in the context of Canada as a whole.

The Chairman: How many labs do we have there?

Dr. Wagner: Very few, really.

The Chairman: We have at least three big ones, including one in Ottawa.

Dr. Wagner: Well, I am thinking of this in the context of the country as a whole. I am not disagreeing with you that one should try to get the maximum one can; but my own view is that it is with regard to the industrial sector itself that you have to say that it would be nice if they did more R & D, even if only in the sense that you use R & D as an indicator of industrial health.

One of the big reasons we do not have much more research and development in Canada is because we have so many multinational companies here, and they simply do not need it. They already get the technology they need.

One of the things we do with our programs, very often, is to convince the parents of multinationals that they should give those companies the responsibilities they might not otherwise have had. Controlled Data is one example, Litton is another, United Aircraft is another, and one could go on and name dozens of them; but I think you have to remember one other important thing when you are looking at technology and industry, and that is that we feel, when we go into a project jointly with a company, that the results of that project should be developed in Canada. In other words, the ground rules are that if we share the costs 50-50, and that is usually the sharing ratio, the development should take place in Canada, and the exploitation should also take place here.

Many big companies do not want to come in with us on that kind of deal. A lot of the foreign owned companies would love to have money, but they will not accept the criterion of exploitation in Canada. They will sometimes, but not across the board. That is one of the reasons why the amount of money you can put into them is limited.

I submit to you that you would not want to see the government putting public funds into industry without having some sort of handle or lever which would enable us to say, “You will develop that and sell it in Canada.”

The Chairman: I do not buy this argument to any very great extent. While I am not aware of the most recent figures, I remember that when we looked at the figures back in 1968 and 1969, we discovered at that time that genuine Canadian companies were spending less on R & D than Canadian subsidiaries.

Senator Grosart: The latest figures I have seen indicate the same situation. They do not seem to bear out your argument.

Dr. Wagner: Well, there is a limit, Mr. Chairman. We cannot force companies to spend money.

Senator Grosart: Are you saying, Dr. Wagner, that you are not in agreement that it would be sound policy for the department to increase federal funding in industry?

Dr. Wagner: No. I most certainly would like to see it increase; but I think one wants to increase it in such a way that it is going to be used effectively. That is the key. Talking of numbers, and trends, and following up the points which Mr. Drahotsky made earlier, I would like to point out that one of the reasons that R & D spending is going down somewhat is not just because of the new economic climate; it is because in fact after about a generation or more of post-war exploiting technology, and making a lot of money out of it, particularly in the United States, Germany and more latterly in Japan, many countries are beginning to realize that they were overspending in many areas, and so they are cutting down in order to get greater efficiency. That is not our problem, but it is in fact what has happened.

Senator Grosart: They peaked. That is the explanation of it. They peaked, but Canada did not.

Dr. Wagner: But Canada's situation is different.

Senator Grosart: What we are trying to get at is why, and what can be done about it. Perhaps there is no answer, but it is very disheartening to think that there is no answer, because, if that is the case, then we are going to fall behind in what is the most important market in the world for us, that is high technology products.

The Chairman: This brings us, I think, to the questions of your review of these programs. I understand you have made a review of these programs and that your memorandum was more or less finalized in September.

Mr. Drahotsky: Yes, we have completed an internal review by the groups involved both on the policy side and on the administration side. We are now awaiting the results of a review by an outside consultant, Mr. Gordon Sharwood, who has been retained to look at our programs with the eyes of an outsider looking at them from the point of view of their impact as seen by the business community. Mr. Sharwood has not yet completed his review but we expect to have it shortly. The intention then would be to bring these different points of view together and come up with a considered view of what, if anything, needs to be done to improve our program framework.

The Chairman: But in the course of making that review, have you made a systematic analysis of the reasons for the weakness in Canadian industry in this respect? Because if you have not made that kind of analysis, how can you improve your programs to fill the need if you do not know the need?

Mr. Drahotsky: We have indeed. We have, in a way, asked ourselves the same kind of questions that you have been asking us. I hope that through my testimony and the testimony given by Dr. Wagner some of the answers may have emerged. There still remains the fundamental question of the overall climate in Canada for innovation. That is, I believe the fundamental question that your committee is also facing, and what can be done to improve the total

climate. I gave some of my views on why the climate is not perhaps as conducive to innovative performance as it is in other countries, at the end of our session last week. Now what should be done to improve the overall climate is another question.

Senator Grosart: Are you optimistic?

Mr. Drahotsky: I am, on the whole, because I would be inclined to argue—but please don't ask me to prove it—that the climate is improving compared to what it was, say, 20 or 25 years ago; that Canadian industry is beginning to recognize that if it is to survive in what will undoubtedly be an increasingly competitive world, it simply has to accept that if you cannot compete on costs, which Canadian industry frequently can not, then the only way you can compete and maintain your performance and ability to compete is through innovation. I have a feeling that that fact is beginning to be increasingly accepted in Canadian industry, from just talking to people in the business community, as we do and as our people do. Perhaps I could ask Dr. Wagner whether he would share that view.

The Chairman: Your optimism.

Dr. Wagner: I think I would say a qualified yes. I do. In the first place I do not have those particulars figures available to me right now, but my belief is that there have been more small companies starting more frequently in the last ten years than we have seen before that. Now, of course, a lot of them failed, but that is characteristic of any growth process and so long as some succeed, even if they become amalgamated with other companies. Often big companies get even bigger by absorbing units when they get to a certain size—units which they would not otherwise absorb. But there is a concern which reflects Senator Grosart's concern about the level of R & D in government. Even though, in my opinion, at a first approximation it is serving the needs of the department, there is nevertheless a genuine and active concern, and things are being done to put as much of that out into industry as possible, a kind of thing that we did not have the same consciousness of ten years ago. In that sense, yes, one can be optimistic.

Senator Bourget: I would like to ask a question in relation to what you were saying about smaller companies. I was wondering if in endeavouring to get smaller companies to take an interest in your programs you are working closely with the provinces. As we know, the provinces are closer to the smaller companies than the federal government is. So what kind of consultation or collaboration do you have with the provinces in the implementation of your various programs?

Dr. Wagner: That is a very good point, senator, and in fact in the last year or two we, and other departments incidentally, have decentralized a very considerable amount of program-type work. For example, in the PAIT program all projects up to sales companies of \$2 million or projects themselves worth \$400 thousand—\$200 thousand government funds and \$200 thousand company funds—which would cover most projects and most companies with the exception of a few of the really big ones—those are all done in the field and decisions are taken in the field in offices across the country.

The Chairman: Before we adjourn, I think we have not been totally fair to our two witnesses this afternoon because some of the questions we have raised have been

very close to being policy questions. So I wonder if it would not be desirable or if it would be the wish of the members of the committee to invite the minister to appear before us on the next occasion.

Senator Grosart: Very much so. I quite agree.

The committee adjourned.

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FIRST SESSION—THIRTIETH PARLIAMENT
1974-76

THE SENATE OF CANADA
PROCEEDINGS OF THE
SPECIAL COMMITTEE OF THE SENATE ON
SCIENCE POLICY

The Honourable MAURICE LAMONTAGNE, P.C., *Chairman*

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Issue No. 8

WEDNESDAY, MARCH 31, 1976

Eighth Proceedings on:

The Study of Canadian Government and
other expenditures on scientific activities
and matters related thereto

(Witnesses and appendices: See Minutes of Proceedings)

THE SPECIAL COMMITTEE OF THE
SENATE ON SCIENCE POLICY

The Honourable Maurice Lamontagne, P.C., *Chairman*

The Honourable Donald Cameron, *Deputy Chairman*
and

The Honourable Senators:

Asselin	Hastings
Bélisle	Hicks
Bell	Lang
Blois	Manning
Bonnell	Neiman
Bourget	Riel
Buckwold	Robichaud
Carter	Rowe
Giguère	Stanbury
Godfrey	Thompson
Goldenberg	van Roggen
Grosart	Yuzyk
Haig	

27 Members

(Quorum 5)

Order of Reference

Extract from the First Report of the Special Committee of the Senate on Science Policy, presented on July 10, 1975 and printed as an Appendix to the Minutes of the Proceedings of the Senate of that day, and adopted by the Senate on July 24, 1975:

"The Committee, therefore, recommends that it be authorized to consider and report on Canadian government and other expenditures on scientific activities and matters related thereto;

That the Committee have power to engage the services of such counsel and clerical personnel as may be necessary for the purpose of the inquiry;

That the Committee have power to send for persons, papers and records, to sit during adjournments of the Senate and to report from time to time; and

That the Committee be authorized to print such papers and evidence from day to day as may be ordered by the Committee."

Robert Fortier,

Clerk of the Senate.

Minutes of Proceedings

Wednesday, March 31, 1976.
(17)

Pursuant to adjournment and notice, the Special Committee of the Senate on Science Policy met this day at 3:30 p.m., the Chairman, the Honourable Senator Lamontagne, presiding.

Present: The Honourable Senators Bourget, Carter, Godfrey, Grosart, Lamontagne, Manning, Neiman, Stansbury and Yuzyk. (9)

In attendance: Messrs. Philip J. Pocock, Director of Research, and Jacques W. Ostiguy, Chief of Administration.

The Committee resumed consideration of its Order of Reference dated July 24, 1975 relating to the study of Canadian Government and other expenditures on scientific activities and matters related thereto.

On motion duly put, it was *Agreed* that the brief presented to the Committee by the Science Council of Canada be printed as an appendix to this day's Minutes of Proceedings and Evidence. (*See Appendix No. 19*).

The following witnesses from the Science Council of Canada were heard:

Dr. Josef Kates,
Chairman;

Dr. Claude Fortier,
Vice-Chairman;

Mr. John J. Shepherd,
Executive Director.

Messrs. Kates and Fortier made an opening statement. The witnesses then answered questions put to them by members of the Committee.

At 5:30 p.m. the Committee adjourned until 3:30 p.m., Wednesday, April 7, 1976.

ATTEST:

Patrick J. Savoie,
Clerk of the Committee.

The Special Committee of the Senate on Science Policy

Evidence

Ottawa, Wednesday, March 31, 1976

The Special Committee of the Senate on Science Policy met this day at 3.30 p.m. to consider Canadian government and other expenditures on scientific activities and matters relating thereto.

Senator Maurice Lamontagne (*Chairman*) in the Chair.

The Chairman: As honourable senators know, we are privileged today to have with us the Chairman and Vice-Chairman of the Science Council of Canada and the executive director and their associates.

Before proceeding to opening statements, I propose that the brief of the Science Council be printed as an appendix to today's proceedings, with the exception of one part of that brief, namely Appendix I. I make that exception because the material in that appendix is readily available in printed form already and it is rather lengthy. Some of the other material in the brief is also available, but I would suggest that we print it since it is rather short and will not involve undue cost in reproduction.

Hon. Senators: Agreed.

(*For text of brief, see Appendix No. 19 page 21*)

The Chairman: I understand that the Chairman of the Science Council, Dr. Kates, and the Vice-Chairman, Dr. Fortier, wish to make brief opening statements. With Drs. Kates and Fortier this afternoon is Mr. John Shepherd, Executive Director.

Dr. J. Kates, Chairman, Science Council of Canada: Thank you, Mr. Chairman. First, may I introduce to you our Director of Research, Dr. Voyer, and the project officer who has worked on this brief, Mr. Miedzinski. If the brief is all right we will take credit, but if it is not all right we will let you blame him for it! There are also other important staff members from the council present today.

Mr. Chairman, honourable senators, on behalf of my colleagues and myself I welcome this opportunity to appear before you to discuss the recommendations in Volumes II and III of your first report, to comment on some of the major issues facing science policy at this time, and to discuss the work of the Science Council itself. You have already received our brief which addresses itself to all three of these topics. In addition, in order to expand a little on the work of our council, we have prepared some opening remarks to show how the council has developed over the past ten years, where it now stands and where it will go from here. These opening remarks are being submitted for your record, but in order to conserve time I propose to tell you only what you will find in these opening remarks, and to

highlight some of the passages rather than reading the entire text, particularly emphasizing our work in relationship to applied innovation, while my associate, Dr. Fortier, is prepared to discuss our position in relation to basic research today.

At the outset we emphasize that when the Science Council was created in 1966 the situation facing the science in Canada was very favourable, due to the obvious success of science in war, in post-war industrial development and in consumer goods such as television, motor cars, modern housing appliances, and so on. We then indicate that due to the adverse economic and social situation of the mid-1970, the environment for the provision of an optimal science input to national problem solving has deteriorated considerably. This situation confronts the council not only with the need to develop studies and further recommendations, but to ensure a wide public understanding and support for our recommendations.

We point out that the highly geographically and sectorially representative character of a prestigious council should be a major factor in developing such public support, particularly as we prove to work in the common national interest rather than for parochial self-interests, and the opening statement then describes our products, which consist of 24 red reports, 34 background studies, or green reports, and other types of products such as special statements, and so on.

We then review in some greater detail the principal recommendations of Report No. 4, "Towards a National Science Policy for Canada," and discuss what happened to the council's principal recommendation, Report No. 4, since its publication in 1968, and since we discussed it with you in previous hearings in the late 1960s.

We believe that the original goals and guidelines of this board are still valid, and that there has been some improvement in the R&D incentives programs and their administration by the government, but we are concerned that this could now be reversing. R&D expenditures have not increased in real terms since 1968. Major programs are under way or are being started in water resources, short-take-off-and-landing aircraft, space communications and oceans, and there has been a significant increase in foreign assistance. Our council itself has examined space science and technology, water resources management and development, transportation, and particularly STOL systems, urban development, computer applications, health care delivery systems, the development of Canada's north, energy resources, integrated resource management, oceanography, and, in collaboration with scientists in the United States and Mexico, the question of climatic change.

Report No. 4 was notable for confirming that the council was looking beyond the laboratory and into the

economy and into society, and it underlined the national rather than the federal approach to science policy problems and challenges, which the council had adopted.

We would now like to discuss particularly report No. 15, better known by its title, "Innovation in a Cold Climate," which further reinforced the council's leadership in ensuring that the economic, social and political implications of science and technology would be more widely considered and discussed.

Initially in that report we discussed the various problems that industry is experiencing, of which you are very much aware, such as market problems, the structure of Canadian industry, our tariff and non-tariff barriers, and so on. Our recommendation in Report No. 15 was that the federal government, in collaboration with the provinces, industry and the universities, should develop a co-ordinated and participatory national industrial strategy which recognizes the significance of innovation and gives priority to industries with high innovative potential.

Among the council's subsidiary conclusions and recommendations were the following. The federal government should use trade negotiations to provide greater access to foreign markets. It should seek greater autonomy for foreign-owned subsidiaries in order to encourage greater product rationalization and greater participation by the subsidiaries in all phases of the innovation process. All governments—that is, federal, provincial and local governments, if possible—should make greater use of their purchasing powers to encourage innovation. All governments should, whenever possible and practicable, transfer to industry any in-house technical work with innovative potential. The federal and provincial governments should explore new mechanisms for the supply of capital to new and to small companies. And industry, for its part, should seek to establish improved machinery for the development of better communications with governments.

I hope you will recognize that these recommendations parallel your own recommendations very well.

Since 1971 the picture has become more gloomy. We still have no national industrial strategy, although the Department of Industry, Trade and Commerce is busy studying possible strategies for over 20 subsectors of manufacturing. Meanwhile, a number of provinces have moved towards the formulation and implementation of strategies of their own. Alberta, for example, has done so. This may have the result that we face danger from a multiplicity of well-intentioned but, in practice, conflicting and counter-productive provincial strategies which are detrimental to the country as a whole.

At the federal level, the government introduced a "make or buy" program in 1972, but no special steps have been taken to use the government's purchasing power to foster Canadian product or process innovation.

A new federal policy to encourage the further processing of natural resource commodities was announced in July, 1973, and in December, 1973 the Parliament of Canada passed the Foreign Investment Review Act, which contains some tests concerning "benefit to Canada" in regard to productivity, industrial efficiency, technological development and product innovation. The government is currently participating, of course, in international negotiations under the General Agreement on Tariffs and Trade. The government has also lowered taxes and increased capital cost allowances for com-

panies in the business of manufacturing or processing. It has transformed the Industrial Development Bank into the Federal Business Development Bank, giving it an expanded role to play in support of small and medium sized businesses. However, industry, for its part, appears to have done little, successfully, to improve the relationship between itself and government.

The rapid deterioration of our balance of payments in the manufacturing process from about a \$3 billion deficit to about a \$10 billion deficit in the short space of three years increases the urgency for improving industrial performance in Canada.

Mr. Chairman and honourable senators, the Science Council has, in practice, stepped beyond the concept developed for it in 1966. But little, in 1976, is the same as it was a decade earlier. Any success we have had has been the result of a number of things: the adoption of a national viewpoint; the admission of economic, social and political information to our studies to supplement inputs that are scientific and technical; the adoption of the role of an "honest" broker; the pursuit of longer term studies; the breadth of the representation of the members of council; and the fact that the council is free to speak to all governments, to industries and universities, as well as to our people.

It is interesting for us to learn how others see us, and I would like to quote from an address by Dr. Alexander King, who is well known to science policy people. Dr. King was speaking at a seminar on "The Research System" at The Hague in June, 1975. With regard to the provision of secondary advice to governments and legislators, he said:

There is . . . a paramount need for bodies able to analyse the proposals of the administration and to give a second opinion. This can be seen as essential in cases where there is some pretention to construct a more participative type of democracy. The bodies devoted to this task must, of course, be thoroughly serious, highly professional and responsible. The Science Council of Canada meets these criteria and its methods and topics of consideration are worthy of study . . .

The opening statement then identifies the major challenges we now face in energy, resources and so on, and outlines the present and anticipated work which our council intends to carry out in order to meet these challenges.

With regard to the current adverse situation being faced by Canadian industry, I recently addressed a major statement to three members of the federal cabinet, the Honourable C. M. Drury, the Honourable Don Jamieson, and the Honourable Jean Chretien, respectively. In this statement I said that while the council supported the government's resolve to curb inflation and to ensure the well-being of the economy, it was critical that the government should proceed very carefully in cutting federal support for industrial research, development and innovation, so as to avoid or minimize long term damage to R&D capability, which has been built up over many years, and which could be hurt very quickly. The Council urged that national priority be given to the support of science and technology in industry.

At the same time I should add that we view with some alarm the continuing cuts—in real terms—in the level of federal support for basic research, and our vice-chairman, Dr. Fortier, will be pleased to provide some further comments on this.

Mr. Chairman and honourable senators, the council will attempt to reconcile Canadian expectations with Canadian realities in the years immediately ahead. This will inevitably take us into the realm of economics and to the resource, construction, service and manufacturing industries. It will also take us into the universities, and into the government sector at all three levels. In all of our work we hope to contribute both ably and energetically and to do what we can to help Canadians achieve the kinds of national goals outlined in our Report No. 4—goals such as national prosperity, high and rising standards of education, and personal freedom, justice and security in a united country. Thank you, Mr. Chairman.

The Chairman: Thank you, Dr. Kates.

[Translation]

We are now going to hear Dr. Fortier from the Laval University who is Vice-President of the Science Council of Canada and who will, according to Dr. Kates, mainly express the Science Council's suggestions and concepts concerning research and support for basic research.

Dr. Claude Fortier (Vice-President, Science Council of Canada): Thank you, Mr. Chairman.

Honourable Senators, I welcome this opportunity to briefly comment on the research situation in our universities. As Dr. Kates is, I am very much concerned about the continuous erosion of federal support for this activity and I consider that the government should examine this problem without delay to assess its implications and try to take the appropriate corrective actions. Obviously, it is imperative to review the university support policy and I shall make a few suggestions in order to make it more consistent and efficient vis-à-vis our national objectives.

Let us recall that federal assistance to university research that was almost inexistent before the end of World War I, has doubled every decade from 1919 to 1969. Universities have particularly benefited from the 1960's economic growth. For example, subsidies from the Medical Research Council increased from \$5 million to \$27 million between 1964 and 1969, that is a growth factor in excess of five over a five-year period. It would have been illusive to expect that such a growth rate could be maintained forever. However, the events have ever since taken an unforeseen turn and during the following years, not only a slowing down or even a levelling of those growing rates could be noticed but an actual decline of the real value of the assistance granted to university research.

Compared to gross national product, support to science and technology research in Canadian universities in 1974 amounted only to between 60 per cent and 67 per cent of the levels reached in 1969. Following the 1975 relative stabilization, the recent government decision to freeze subsidies will for the current fiscal year probably result in a decrease of the total aid to University Research to 60 per cent of the corresponding value for 1969.

Just like the other economic sectors, universities have suffered from inflation and must obviously be included in the measures to check it. We must nevertheless note that the financial constraints currently forced upon university research are seriously jeopardizing its performance and the continuation of the present tendency would even endanger its very survival. An already evident consequence of this is the breaking up of research teams that have been patiently and laboriously put together for several years. It will inevitably reflect on the quality and the scope of university research. The effect of the resulting climate of uncertainty is not less serious on the morale of those whose career is research and on the attraction of such careers on those who wanted to follow their lead. In short, the unfortunate impact of over-restrictive measures on a vital resource for the nation seems out of proportion with the relatively small savings they can generate.

In the background reports or studies made by the Science Council on the applications of science and technology to various problems such as our space program and hydroelectric resources, earth sciences, data processing, the dissemination of technical information, the ocean or health services policy, there are frequent references to university research and its essential role in the conservation and development of our technological basis. Two Council reports mainly centered on university research deserve to be mentioned as much for the principles that they contain as for the relevancy of their recommendations. I am speaking about report number 5 on federal government university research support published in 1969, and report number 18, published three years later on the objectives of a Canadian basic research policy.

Those reports are summarized in the text we have tabled.

Mr. Chairman, honourable senators, I shall not dwell longer on the justification of the university research objectives, whether it be basic, strategic or applied research. This justification is found in our presentation.

On the other hand, we know that the Federal Cabinet will soon introduce legislation to modify some aspects of the university research subsidies system and that federal-provincial consultations on post-secondary education funding will result in the negotiation of a new agreement next year, the difficulties of which we are not underestimating, particularly as regards university research support. The role of the provinces in this field is being reassessed which would be much easier if better communication channels were created between the decision-making officials at the two levels of government and the university representatives. We are, besides, convinced that Canada can no longer depend on other countries for the scientific knowledge and the technological expertise we will need to meet the kind of challenge Dr. Kates referred to earlier. We also know that researchers' training is a long-term undertaking and that those who go into this field often give up more attractive financial prospects. Considering these various factors, I shall make three recommendations reflecting the Council's past positions, and to which I shall, with your permission, add two suggestions which will not commit the Council as they have not yet been discussed at that level, but nevertheless seem relevant to the development of a consistent university research policy.

First of all, a higher proportion of university research should be aimed at sectors of special interest to Canada while continuing to meet the university essential objectives.

Secondly, the federal subsidy system implying an assessment of the applications by peers should remain the basis of university research support.

Thirdly, the amounts allocated by the federal government to agencies subsidizing university research should be brought back as soon as possible to the percentage of the GNP they represented in 1969. This level should be adjusted in the future to provide for inflation and others factors particularly affecting the cost of research. But this readjustment should, first of all, take into account the number of researchers required at every level to meet the scientific and technological challenges that our society is faced with.

The two following suggestions are made without any commitment and not on the Council's behalf.

I consider that the federal government should expressly and formally extend to universities its "Make or Buy" policy originally developed to promote research and development in the industrial sector. Giving out contracts to university researchers through this device would, by ensuring them an alternative or supplementary funding source, be a remedy to the discontinuity of grants and the unforeseeable fluctuations of their level. It would besides encourage research to be directed towards problems more directly centered on the community's needs, facilitate the regrouping of individual researchers in multidisciplinary teams more able to solve those problems and would thus create a climate particularly favourable to co-operation between researchers in the academic and industrial sectors.

Finally, in my opinion, the provincial governments should as far as they possibly can or through mechanisms to be specified within the federal-provincial negotiation have a more important role in the correction of regional disparities by granting development contracts, subsidies or by a united action to strengthen teams as well as by granting scholarships and establishment grants to young researchers. Those provincial programs, a few prototypes of which already exist, could considerably supplement the federal research assistance activities and seem particularly appropriate to the carrying out of regional objectives.

Mr. Chairman, Honourable Senators, during your first round of hearings, the strong growth of research in our universities was markedly contrasting with the situation prevailing in the industrial sector for which you had suggested urgent remedies. As Dr. Kates stressed it earlier, the federal government's recent decision to considerably cut the amounts allocated to industrial research and development might put a halt to activities that just began moving in this field. You will agree that my brief comments on the present academic research situation are no justification for a complacent *laissez-faire* attitude and, while making allowance for the present economic problems, the Science Council can not allow our development prospects to be jeopardized by measures of restraint, the long term consequences of which have not been sufficiently assessed; by analogy, they remind us of the savings a farmer would like to make on seeds and fertilizers when expecting a poor yield.

The Chairman: Thank you, Dr. Fortier.

[Text]

Now I am entirely in the hands of the members of the committee. Up until now our procedure has been to ask general questions at the outset, then proceed to the brief. In my opinion, this procedure has proven to be relatively slow and I propose today that we reverse this procedure and go to the brief first. Later, not necessarily today but at another meeting, any general questions we may have in mind could be raised. In this manner we may have less duplication. However, for today, as a kind of transitional system I would certainly entertain questions on the two statements we have just heard, if honourable senators have questions which they consider are not touched upon directly in the brief.

Senator Godfrey: Dr. Fortier, you said in the Science Council recommendation that the grants to universities should be more mission-oriented. Then your personal belief was that the "make or buy" policy should be extended to universities. What is the essential difference?

Dr. Fortier: Senator, I was referring to the recommendations of Report No. 5, stating that a larger proportion of the research in the universities should be mission-oriented, that even basic research should be mission-oriented and more related or relevant to such problems as the environment and pollution, Canadian problems pertaining to oceanography, geophysics and cold adaptation, in larger proportions. So this referred to the type of research to be carried out in the universities. The same report also stimulated, or directed councils to provide subsidies and so forth to all types of research, whether fundamental, mission-oriented, or applied.

With respect to the second suggestion, which I stated was not actually a council suggestion, but is presently being debated, it pertains to a formal extension of the "make or buy" policy to make it more acceptable or amenable to university conditions and environment and provide the advantages I have stated, one of them being to facilitate the interface, or the interaction between investigators, or teams of investigators in universities and in industry.

[Translation]

Senator Bourget: Mr. Chairman, may I ask a question?

The Chairman: Certainly.

Senator Bourget: Dr. Fortier, you referred to provincial projects. Ever since the creation of this Committee you have implied that there is a lack of cohesion between the three solitudes, I mean the federal government, the provincial governments—I should say the four solitudes—the universities and industry. I wonder—you have referred to it earlier and I think you made a recommendation—what situation prevails today as to the contacts between the universities, the industry and the federal government—that is the federal government agencies?

Dr. Fortier: On several occasions, our brief refers to those three solitudes which have been mentioned by your Committee, I believe.

The Chairman: They are four.

Senator Bourget: I have four of them—but I should like to know what the provincial government is doing under the circumstances?

Dr. Fortier: The Council is making an increasing effort within its national role, to act upon or influence the two levels of government and the private sector whether it be industries or universities. What has been done in this direction may not have been done formally but in the form of recommendations, suggestions, contacts and dialogues.

For example, at the last Science Council meeting in Quebec one of the principal reasons for choosing this location was to meet the members of the relatively recent Quebec science policy council, to create close relationship, to determine what their objectives were and to what extent the Science Council could help them, to give them advice at the administrative level and direction level and to determine the compatible areas between our two respective missions. Those contacts were cordial and friendly and had tangible and concrete results.

I give this as an example—but there are several others...

Senator Bourget: Are there any in other provinces?

Dr. Fortier: Yes and the meeting before last was in Winnipeg where we similarly met the Manitoba Agriculture Council to establish the same kind of relationships and to assess the impact of our decisions in the light of their own responses because this objective is twofold: first of all, define the participation or cooperation areas and then have those agencies respond to our own recommendations, responses which we eventually take into account.

Senator Bourget: Thank you.

[Text]

Senator Grosart: Mr. Chairman, in the paper that we were given, the abbreviation—I do not know whether the chairman's statement was an abbreviation of the paper, or the paper is an abbreviation of his statement. However, it is called "abbreviated version", but seemed to be somewhat longer than his statement. Of course, the crucial comment is contained in page 7, that federal government expenditures on R&D and on innovation, while they have increased since 1968 in dollar terms, have not increased in real terms and are now to be frozen. This raises the whole question which is discussed in the presentation, as to what the levels of expenditure should be. I do not really want to refer to the report at this time—

The Chairman: You do not want to be ruled out of order.

Senator Grosart: My recollection is that on this very vital question, the presentation takes issue with the use of these percentage of GNP indicators in a normative way. I am sure the objection isn't to a normative approach, but to the use of these particular indicators in a normative way. You have some doubts about this committee's recommendation of 2.5 per cent by 1980. The Science Council has some doubts about its own recommendation of 2 per cent by 1973. Yet you come back over and over again and say, "we must have an increase in these expenditures". How are we going to make a policy

decision if we do not have some indicators that we use in a normative way?

Senator Godfrey: That is on page 18 of the brief, the second paragraph.

Senator Grosart: It was discussed earlier, but that is where the word "normative" is first used. What kind of indicators are we going to use? We are talking about national science policy. Do we just say, "We will drift along and hope that it will get better next year," or do we say to the government, "You have to spend X dollars next year"? This is the whole essence of government policy, as it is expressed in the main estimates when the government says what it is going to spend. If we are not going to say to the government, "You should be spending at a certain level," how can we help the government to come up with an effective national science policy?

Dr. Kates: I quite agree that we have not provided an answer to that. The difficulty appears to be that it is very difficult to set a global measure. They would probably have to set measures that are closer related to the various programs. The problem of setting a global measure is that the government might then set a measure and say, "Well, in every program that we undertake we are going to spend 2 per cent of GNP, or the appropriate fraction of that, on the program, and the need for R&D and innovation will differ widely from program to program."

For example, I think it is practical to say, if you are going to have medical expenditures of a certain amount, that 5 per cent or 10 per cent of that expenditure should be spent on R&D, because if you spend less, the remaining 90 per cent to 95 per cent of medical expenditure might not be used as efficiently as it might otherwise be. In another field, that figure might be quite different. I concur with you that our expenditures by international standards are low and should be higher. We find it difficult to hit a particular number.

At the present time, of course, for the immediate short term, it is a purely academic question. At the present time we are much more concerned about seeing that the situation does not deteriorate further rather than hoping to get any radical increases. In other words, if the situation, as Dr. Fortier has proposed, could be established, at least we would try to reach the 1969 levels of expenditure in the R&D area. For the short term, until we overcome the present economic malaise, that is probably the problem. But I quite admit that your committee has had the courage to state a very simple criterion for this expenditure. The same criterion has, in fact, been used in foreign aid, where Canada has committed itself to one per cent. I would say that if it cannot come up with a better one, we should adopt yours.

The Chairman: It seems to me that you have adopted it. This is a case of again trying to build a straw man, kill it, and then doing exactly what we have said. You seem to say in your report, "While we were completely unrealistic in proposing this normative indicator"—with all the restrictions and qualifications you put in your report—"We have done it ourselves at 2 per cent." I do not think it was the same dates. You then come back later in the brief and say, "We think this 2.5 per cent should be a very desirable thing." Therefore it seems to me that there is some kind of inconsistency.

Senator Grosart: That is my problem. When you sum up and say what it should be, you seem to reach the conclusion that probably the Senate committee's 2.5 per cent by 1980 is it. There seems to be an inconsistency there.

The Chairman: From what you have just said, you accept that setting targets may be desirable—of course, always within the scope of worthwhile projects. You said that we should go back to at least the level of 1969; that this is the target.

Senator Grosart: Is there any other way to get the government to spend effectively on science technology, and particularly on innovation, other than by telling them how much they should spend, other than that input from the science community? It seems to me that I would go the opposite way. You see the problem as making the base norm apply in every sector. I do not think that problem has arisen, but it seems to me that the science community itself should be doing it the other way—in other words, adding up the necessary costs, discipline by discipline, sector by sector, and saying that it adds up to so much. You would then say it should be a percentage of GNP or so many dollars. I think the advantage of using a percentage of GNP does relate it to the potential of the economy to pay it. Is there any other way?

Dr. Kates: Let me comment a little further, because I may have given you an unduly negative impression. The reason we have not approached it in quite the same way as your committee was as stated in our Report No. 4. We had proposed a strategy which was called a major program strategy. In that report we pointed out that if that strategy was implemented by the government it was our expectation that the gross expenditures would well exceed the 2 or 2.5 per cent level and they would find their level in precisely the way that you have just indicated, by each program working out what its R&D expenditure would be.

The disappointment we have is that compared to the number and size of programs that were advocated at that time, as I have indicated, far fewer programs have been implemented; because it is not sufficient to say, "Spend a certain amount." You need to point out how the money should be spent; otherwise there is a danger of the money being wasted. Unless there is a very good purpose for spending that 2 or 2.5 per cent, even we may not be in favour of seeing it spent. We need to have some cart to attach the horse to. If you will allow me, I would like my executive director to comment on this matter.

Mr. John Shepherd, Executive Director, Science Council of Canada: I just want to add to the *mea culpa*. I think it was incorrect for the council to attack a target and not suggest an alternative target. I think that the idea of targets if accepted would have led to a rather higher level of R&D than pertains now. I think that the approach that is going to have to be adopted is an extremely comprehensive attack on an analysis of major programs and priorities, and to link to that strategic research or otherwise basic research. That is a task that I think has to be done, and the council has to play a role in doing it.

Senator Grosart: It is so often forgotten that you are dealing with a political problem. It is no different basically from any other political problem, such as how much we should spend on transport or agriculture. I do not know of any other way to attack it than by those who are concerned coming to the government and saying, "Here is what you should spend, here is why, and here is what you neglect at your peril or the peril to Canada," because your presentation says that we are in a perilous situation. I come back to my original question concerning the community, the Science Council, SCITEC, the individual disciplines, universities, industry, the departments themselves: how are we all going to persuade the government to do the opposite of what they are doing now if someone does not do this? If we do not, it will not be done. This committee is not going to last forever.

Dr. Kates: This is something we are just looking at. We may be more helpful on this question than our early replies indicate. The big problem is that the scientific R&D expenditure tends to be one that can be readily cut in a period such as we are going through presently. It is not a social program for which there is a government commitment. We are now looking at the question of whether we should not recommend a policy similar to policies of other countries whereby a great deal of R&D expenditure is tied to related programs.

To give you an example, the very large interstate highway program in the United States, ranging in the hundreds of billions of dollars, was entirely financed by a two-cent per gallon tax on gasoline, and one of the requirements was that 1½ per cent of those funds had to be expended on related research.

If you look at other programs in the United States and other countries, similar policies can be found. I believe that Canada ought to adopt a policy of putting 5 per cent of the health dollar into research and development in the field of health. In adopting such a policy, one has to bear in mind that the politicians are unlikely to cut the R&D part of the health dollar, but not the health dollar itself. This type of thing tends to become built into such programs. However, such tied R&D programs are somewhat more immune to the kind of cutbacks that occur nowadays.

The criticism of that kind of political philosophy is that there are some R&D programs that are not readily linked to some major program, in which event they would be subject to some disadvantage. However, the government could arrive at appropriate R&D expenditures in such areas relative to the R&D expenditures in fields such as health, and so forth. By following such a course, we could greatly increase R&D expenditures in this country. There may be a solution in that direction.

The Chairman: Just to conclude discussion in this area, in proposing a figure of 2 per cent, you do so more or less on the basis of the internal needs of the country, whereas when this committee proposed a figure of 2.5 per cent, we did so on the basis of international comparisons. We did not say to the government that such a goal should be achieved by the year 1980; we did say that if that goal was not achieved, Canada would be in some difficulty in the scientific field.

Both methods are ways of arriving at normative indicators. I hope that when this area is dealt with at a later date, the Science Council will not say that the Senate

committee did not know anything about this and should not have followed that approach. I hope we will be working on the same wavelength.

Dr. Kates: If I may comment on that, Mr. Chairman, unfortunately, some of our past briefs—and possibly the present one—gave the wrong impression of the feeling of the Science Council towards this committee. We believe that organizations such as this committee and the Science Council of Canada, and others, have to reinforce one another. The total science and technology sector is facing very serious problems today. We see this committee as an ally in overcoming those problems. We are both looking for a stronger, healthier science and technology situation in this country.

The Science Council will be very careful in the future to spend more time looking at those recommendations of this committee with which we agree and reinforcing them, instead of singling out a few recommendations with which we differ. In future, we are going to elaborate both on those recommendations of this committee which we support as well as those with which we disagree.

Senator Grosart: If it is any comfort to you, Dr. Kates, that attitude comes through very clearly to me in your presentation. Perhaps we have had our period of confrontation, as all good marriages do, and we are now coming, on both sides, to live with our differences in a more realistic way. That does come through in your presentation. I think we would all agree that we did have our times of confrontation.

On page 9 you make the statement:

no special steps have been taken to use the government's purchasing power—

The Chairman: Are you on the brief now, Senator Grosart?

Senator Grosart: No, I am still dealing with the opening statement. I might say, Mr. Chairman, almost anything said in the opening statement is covered somewhere in the brief.

Senator Godfrey: Should we not, then, revert to our original plan?

Senator Grosart: Well, the chairman asked for comments at this point.

Senator Godfrey: My question was something that was not in the brief. I think we should stick to things that are in the brief.

The Chairman: Perhaps you could ask this as a final question, Senator Grosart.

Senator Grosart: It is entirely up to the chairman what procedures he wishes to follow: I am just doing what he asked us to do.

The statement is:

no special steps have been taken to use the government's purchasing power to foster Canadian product or process innovation.

And you relate it to the "make or buy" program. That is a fairly strong statement. Could you elaborate on it, and perhaps outline what special steps might have been taken, or could be taken, in this particular area?

Dr. Kates: I think I can best reply by giving you an excellent example of this. I read yesterday a brief submitted to the committee by Bell Northern, where Bell Northern points out that it has the largest industrial laboratory in Canada. Why was that laboratory possible? It was possible because Bell Canada presented such a huge market for Northern Electric.

If, by analogy, we look at Canada, total government expenditures in Canada today represent 30 to 40 per cent of the GNP, representing, by far, the largest single market in this country. The biggest problem for Canadian industry is finding a market. If all levels of government, including non-profit organization supported by one government or another, could be concentrated to form one large market, we would have a market within which we could sponsor large successful companies in the same way that Northern Electric grew on the market of Bell Canada.

This is not now a policy in Canada; on the contrary, the Canadian market is extremely fragmented. To give you an example, in my own field, transportation, practically every city in Canada is buying, or has bought, different transportation equipment. While we are a transportation conscious nation, we do not present a strong cohesive market for Canadian transportation companies, with the result that we are not strong in a field in which we ought to be strong.

Senator Grosart: Are you suggesting, then, a special kind of highly concentrated "buy Canadian" policy, where possible?

Dr. Kates: Yes, where possible. We are a trading nation. It has to be selective. There are a number of areas—particularly in those fields in which total government expenditures are very high, such as transportation, health, education—where the government, as a policy, could decide to foster a very strong Canadian industrial capability.

Senator Grosart: Going to page 10, you make a further statement about a component factor in this problem. You say:

However, industry, for its part, appears to have done little—successfully—to improve the relationship between itself and government.

Is this part of the same problem?

Dr. Kates: No, this is basically a problem of communications and attitudes. As this committee has pointed out, if one goes to a meeting of industry, you will hear industry poor-mouthing the government; if one goes to a government meeting, one will hear the politicians and bureaucrats poor-mouthing industry. These two sectors have to get together in the interest of Canada.

Senator Grosart: Is there an area in which, if on the one hand the government decides to concentrate its procurement policies in the way you suggest, there is a tremendous role for industry, to suggest how this should be done? Has industry ever made any effort to do this?

Dr. Kates: I think Mr. Shepherd would like to speak to this.

Mr. Shepherd: It is not just a question of communications between the two sectors. As major programs

develop we feel that industry should cooperate in joint ventures and putting mergers together that will enable them, because of their enhanced technical and financial strength, to quote upon much larger programs than has hitherto been the case because of the fractured state of many industries. We feel that there is a very definite responsibility on the part of industry, not only to communicate better but to put itself in an organizational posture to get some of the large programs that are currently denied to it because of its weaknesses.

Senator Grosart: The British did this some years ago in the electrical industry. How successful has that been?

Mr. Shepherd: I am not acquainted with that specific example.

Senator Grosart: My recollection is that they decreased the total number of separate companies in that field from about fifteen to three.

Mr. Shepherd: I do not know that specific example. In terms of these international analogies, one sees German procurement and German industry and notes an intense concentration by government on supporting procurement to its own technical base, but also the very rapid ad hoc development of industrial mergers to meet large-scale programs for the length and purpose of that program. Canadian industry, perhaps because of ownership and for other reasons, does not seem to show that flexibility of response to major requirements, and we think that is a very definite shortcoming which is inhibiting this process.

The Chairman: I am sure we will come back to that during our review of the brief.

Senator Carter: I should like to congratulate the witnesses on the brief, which I find very encouraging, particularly the statement on page 5, where they say that the hearings we are now having:

... could hardly be more timely, or the subject more urgent and more closely related to issues of crucial national importance.

They then go on to say why; that proposals that have been made for the support of science in Canada lie dormant, that science and technology are still accorded a low priority, and universities and the industrial sectors confront imminent crises. This indicates that the goals of the council are identical to our own. You have posed the problem, but can you elaborate on that and tell us why we have been so unsuccessful in getting a little more interest in science and technology? Why are the proposals lying dormant? Have you any ideas? Is there anything more we should have done?

Dr. Kates: There are quite a number of answers. The background, of course, is the economic and social situation that has developed since the late 'sixties. In other words, until that time we were in a period of very rapid growth. Funding grew at the same time. Since then we have encountered very large economic problems, and also quite a number of social problems. The political realm generally has a much shorter time horizon than that within which we are working; we are supposed to work in the medium to long-term, five to 25 years, and even longer term, whereas, as you appreciate, the poli-

ticians are necessarily focussed on the much more immediate situation. It is quite obvious that they do not see that support for science and technology will solve the immediate problems. Maybe some support 10, 15 or 20 years ago might have lessened the immediate industrial problems we face now. That seems to be the background against which we operate. The question is what can we do positively about it, and that is what we are now addressing ourselves to.

Senator Carter: I think you said earlier that we have somehow failed to communicate the urgency of the situation.

Dr. Kates: I believe that is correct, but it is understandable. In retrospect, in 1966, when the council was created, there was very little reason not to expect the recommendations of your committee and our council to be adopted quickly. In fact, the Council was constituted in order to sort of rationalize how to use these rapidly mounting expenditures. We now have to recognize that public support for longer range proposals has to be developed. If a sufficient number, especially of the highly concerned public, become concerned about the longer range—in fact, there are a number of signs in Canada that more and more of the public are becoming concerned about such longer range problems as environment, pollution and so on—then I believe the politicians will also make provision for solving these longer range problems. This is certainly one way. Another way, which I have just indicated, is that we may have to become more specific in how to integrate these proposals into law-making philosophy, so that in fact the expenditures are being secured in the same way that, let us say, social expenditures are being secured.

Senator Carter: Earlier, in reply to Senator Grosart's question, you spoke about the rate of funding being increased to 2 per cent of GNP, which is the target we suggested. You pointed out that having the money, that 2.5 per cent, would not necessarily mean you would get the best value, because it would depend what programs you spent it on. Does it not also depend on the capacity we have for industrial research in our industry? Has the council made any assessment of that, of where the weak spots are and what parts need to be reinforced? If this is to be put across to the people, it has to be put in terms that the people understand. I am thinking about jobs, high technology and the relationship of high technology to increased employment, the number of jobs. In my mind, that is related to the capacity we already have, and probably the deficiencies that we have, in our capacity for research and innovation.

Dr. Kates: At the present time the problem is that the current picture does not encourage capacity to be developed. In other words, certainly in the universities, as Dr. Fortier has outlined, there is no attraction to a young bright man to take the research route, particularly in those areas where he can take an alternative business or professional route. At the same time, industry is in a rather difficult situation and also does not offer a very rewarding career to a young researcher. I do not think we have a problem of immediate capacity, because I do not believe there is any likelihood of an extremely sudden change. In other words, even if the government adopts a goal of 2.5 per cent, that would take place over, presumably, something like five to ten years, or longer,

and certainly during those years if a more encouraging environment is developed this capacity would be built up.

The Chairman: I think what Senator Carter had in mind was more or less the link between the council and the government, and he was deploring the fact that some of your recommendations were not adopted very quickly. I note that in your brief you refer to what we said, that the government does not need two frustrated advisory bodies, and you try to refute that assertion of ours and say that the council has not felt frustrated over the years. It seems to me that you are frustrated.

Senator Grosart: Or should be.

The Chairman: I recall very well also that when Dr. Solandt was before us in 1968 he was frustrated. At that time he deplored the fact that there was a vacuum at the centre or at the top. Has this vacuum been filled since then? For instance, how often do you see the minister? At that time the council was reporting directly to the Prime Minister, of course. I understand that you now report to the Minister of State for Science and Technology.

Senator Bourget: That will be another solitude.

Dr. Kates: The matter of frustration is highly personal to me and I believe to my colleagues and our staff. But the situation does provide a challenge which we believe is soluble. As I have outlined in my opening remarks, I do not believe the record is all black. In other words, I outlined a number of responses, and although we cannot tell exactly whether these were responses to our recommendations, it is certainly true that in quite a number of these programs our recommendations contributed to producing a climate which enabled favourable responses to occur. The problem is that some recommendations have been acted on; some have not been acted on; some have been acted on only in part. It is not an entirely black picture, therefore.

With respect to our relationship with the government, we certainly agree with Mr. Drury that the business of translating broad science recommendations, such as emanate from your committee or from us, is the business of MOSST. We believe our business is to develop those recommendations and, particularly, to develop support among that part of the public interested in that area. We believe we can improve our batting average on that in future.

So we are quite happy with the role of what we would call an external agency as contrasted with the role of an internal agency. In the role of external agency we do not believe that the frequency of access has to be over-emphasized. In other words, we do not have to sit at the minister's side or at the side of the Cabinet. It is the business of MOSST to shepherd, basically, or to stick-handle our recommendations through the more detailed governmental processes.

The Chairman: But when you make recommendations to the government, surely it is important to meet the minister and draw his attention to the various studies and reports. How often do you meet him during a year, for instance?

Dr. Kates: Since I took over the chairmanship last October, I have met Mr. Drury three times.

Senator Godfrey: Your performance is better than that of the Canada Council. When I was a member it was four years before we met Mr. Pelletier. It was only at my insistence that they finally got around to acknowledging his existence.

Dr. Kates: I must say that Mr. Drury has never refused to see me. I have requested meetings on three occasions, and on each occasion it was in short order that we had our meeting. I presume that if I had asked him to meet with me on six occasions, there would indeed have been six meetings.

Senator Godfrey: I should hasten to point out that it was not because Mr. Pelletier did not want to meet the Canada Council that there were no meetings. It was simply that the Canada Council thought it should maintain its independence by having nothing to do with a political arm of the government.

The Chairman: In other words, the Canada Council did not want to meet with Mr. Pelletier.

Senator Grosart: That brings us to the "Second Opinion" role of the council. You quoted Alexander King on that. Apparently he complimented you on the success you have had in the second opinion role. My impression is that this is a role you have almost neglected. It would seem to me that the second opinion role for the Science Council would be to come out at least annually to say to the government, "You are wrong," and not just point out general weaknesses.

On page 5 of your brief you indicate that the main problem is to change "the organization for the support of science in Canada". I agree that that is true. But then when I looked with great expectations to see what changes you would suggest in the organization for the support of science, I was disappointed. I assumed your six critical weaknesses were there, but by and large they are not changes in the organization for the support of science.

I come back to national science policy and I say that it has to be on the basis of a structured organization. You say, "Well, we need more money." That is not an organizational problem. You say there should be concentration on the so-called national goals. I hope you are not going to waste any more time on that. Then when you came out with the report on "National Goals" I was impudent enough to make the remark that that was exactly what I would have expected from a Grade 12 student, except that he would not have left out "transport." "National goals," to me, is a meaningless approach, because you merely say what everybody says we should have. If you have twelve, what about thirteen? Does that cease to be a national goal? What about fifteen, and so on? If you become specific, as I think you do to some extent here, it is still on the same old categories: oceans, transportation. Everybody knows that these are the areas in which we have to concentrate.

If you are talking about a change in organization, the decision-maker would like you to tell him what change he should make to get into ocean technology, for example. What changes does he have to make in order to get a decision to do it? It is the same all the way through: industrial strategy, contracting out policy, attraction of talent, and so on. It seems to me you do not say what

changes are needed in the science policy decision-making organization to do the job.

I have looked at all your annual reports, and nowhere do I see you coming out and saying, "Here is a second opinion to the political decision-maker: you are not doing it right."

The Chairman: There are some comments in the brief, but only to say that they are against our proposals for reorganization.

Senator Grosart: I am not quarrelling with the objection to some of the Senate committee's specifics, particularly concerning the councils. That is understandable. The major problem is how to get an organization at the science policy decision-making level which will do the things we all know should be done, whether it is concentration or contracting out or whatever. In effect, you say the contracting-out policy is a flop.

Dr. Kates: Oh, no.

Senator Grosart: I think your phrase is that "it has not materialized on a scale sufficient to meet its objectives", which is as good a definition as I know of a flop. If it has not developed to meet its objectives, then it has failed and, to me, that is a flop. I will leave it at that. Perhaps you will make some comments, because I have always hoped to see the Science Council take the lead, take the objective approach and talk directly to the government.

Dr. Kates: I will comment on the problem of organization, and Mr. Shepherd will comment on contracting out.

The basic organizational recommendation which we made fairly early in our deliberations, if I recall correctly, was to have a science ministry so that these recommendations could be moved properly into the governmental process. This ministry has been established for that purpose. It has also undertaken to work out such programs as contracting out. I believe we have made quite a number of other organizational proposals. I believe the environmental council was one of the recommendations made at one time, and I believe almost every one of our reports contains quite a number of organizational recommendations. On the research funding one, I believe we were instrumental in suggesting how the three-council system should be set up, as well as the coordinating council. I cannot list all of them for you, but I do believe we have made quite a number of organizational recommendations in the past. What you say, senator, is very much in our minds, and you may find us being much more concrete in the future, though I do not admit that we have not been concrete in the past.

Senator Grosart: I am not saying you have not made organizational proposals—and I use the plural form there—but you say, "It is to change the organization." We can all make all sorts of proposals. We have in our report; you have; and MOSST has—as have the universities. Everybody has made proposals. You fascinated me, however, when you used that phrase, "the organization for the support." That is what we are looking for here, because that is what national science policy is. We are looking for the organization that will produce science policy that is the best policy for Canada.

The Chairman: And you say that in our report on this general problem we have favoured the system of horizontal integration, as opposed to vertical integration. I would question this, but you do not go on in your brief to describe how you would re-organize the over-all structure, or organization, according to the approach that you seem to favour.

Dr. Kates: Let us get back to this over-all organizational picture for which we have recommended an agency, such as MOSST, that could coordinate science policy and develop science programs that did not fit within a particular line department.

Senator Grosart: May I interrupt you there for a moment, and perhaps make my approach clearer? I had hoped that the Science Council would come out immediately and object to MOSST being made a second-rate ministry. It is so named. It is a ministry of state, and not a full ministry. The Science Council, as I recall, was silent on that situation. That is the kind of thing I mean.

Senator Godfrey: "What's in a name?"

Senator Grosart: "What's in a name?" That was the start of the catastrophe.

Dr. Kates: It is a debatable situation and I do not think, really, that anyone knows the answer. I have watched very closely the situation with regard to ministries of state in Ottawa. In Ontario, as you know, they have tried the opposite tack of creating super-ministries, but the super-ministers in Ontario seem to be rather lonely and unhappy. They were supposed to have the kind of role that we might have advocated for MOSST, but looking at the actual experience of super-ministries in Ontario, I am not sure that that idea would have been all that much better.

The problem nowadays seems to be that when you have a ministry which is supposed to have a policy and a coordination role, whether it is above the other ministries or below them, it appears to face very considerable problems vis-a-vis other very strong and much older ministries.

Senator Grosart: We know this.

Dr. Kates: I have a feeling that you, senator, have far more know-how in this area with regard to solving that problem than we scientists and engineers; but it is a very serious problem. I do not know that challenging the status of MOSST would really have provided a solution.

Going back to the organization question, let me point out that we have made a number of what I might call over-all organizational proposals, and I will not go over them again. Coming specifically to your proposal, which we interpreted as calling for the separation of, let us say, the communications laboratories from the Department of Communications, and perhaps the survey laboratories from EMR and so on, and putting them together in a separate entity, and orienting them more closely to industry, we fully agree with your objectives—we would like to see a lot of these laboratories oriented more sharply towards industry; but what we are wondering is whether, if we were to undertake such a reorganization, you would be entering upon a very, very lengthy,

cumbersome and expensive process, and whether that process would really produce the kind of objective you are aiming for. When you watch the history of large reorganizations in large government departments, you note that for five or ten years they are busy just reorganizing, and get fully taken up with the process. When you move big pieces along you sometimes lengthen the lines of communication and in the end result we are a little sceptical that this sort of thing would really achieve the objectives you have in mind. The objective of relating these laboratories more closely to industry, we believe, is not a "top-down" process; it is a process in which you really have to instil in the middle and upper echelons a regard for industry. You have to develop such a relationship. I am sceptical that moving pieces from one big ministry over to another one would achieve the required purpose, but I fully support your objectives.

Senator Grosart: I agree with you entirely, but I repeat, sir: "Are you really saying that you did not actually mean that it was important to change the organization in Canada for the support of science? Are you saying now that that is not what you meant; that you meant to move a lot of small pieces and not move any big pieces?"

Mr. Kates: No. In our reports, where we have recommended various programs, we have recommended what organization ought to be set up for them, and where these programs most logically belong, whether it was a question of a new organization, or one of the existing ones; so if your question is directed to suggesting that there is, as it were, some overall organizational solution in Canada, I do not quite agree with you. We do not believe you will find an answer in some kind of supra-organizational deal. For these various programs you undertake, you have to study what the best organizational environment for each one is.

Senator Godfrey: I would like to carry on with what Senator Grosart has been saying.

Over the weekend I read the annual report of MOSST, and then I read your submission here, on page 21. Without wishing to pit the one against the other, it seemed to me that you were both trying to accomplish the same thing. Then I looked at the top of page 23 and saw this statement:

The budgetary role of MOSST is important and should be strengthened. A stronger role in budgetary matters could develop as MOSST gains experience. However, the future of the Ministry should not be as strongly predicated on a budgetary role as the Senate Committee has suggested.

That is the only statement that I could find in all that you have said about MOSST that gave me the slightest inkling as to whether MOSST is performing or whether it is not. Is it doing the job it is supposed to do? Is it doing all the things you recommended, which, as I recall it, they claim they are doing in their annual report. I would hope that you people, as an outside, independent agency, would be able to give us some advice as to whether you think it is working or not.

Dr. Kates: As I understand it, MOSST's role at the moment is one of putting numbers together, and of giving advice, together with the Treasury Board. I also understand, however, that MOSST is in the throes of reorganization. It is a relatively young government agency, and I think the difficulty we would have at this time is to decide whether, in a huge undertaking like this, it is not a little too early to try to assess them.

Senator Godfrey: But they are supposed to be doing the things that you have already suggested.

Dr. Kates: Those are the objectives we proposed, but, you know, they are just putting the organization together—hiring people, and just getting under way—so my feeling is that in a situation like that you have to give them two or three years before you can judge them.

Mr. Shepherd: I would like to speak to this, Mr. Chairman, if I may.

At a very practical level MOSST is performing exceedingly well now as compared to the way it performed two or three years ago. It is struggling manfully to make the contracting out policy work, for example; it has established very effective relations with many mission departments; it is being extremely co-operative in science policy problems such as the transfer of technology from government laboratories to industry; and there is every indication that at that level of practical, low profile co-operation, MOSST is indeed performing very much better than it has hitherto.

Senator Grosart: Agreed.

Senator Carter: I would like to come back to my earlier question about research capability, and I refer to page 13 of the brief, where you state:

The pressures of indigenous development of technology and of the selection and acquisition of foreign technology will place increasing demands upon Canada's capacity for basic and applied research, which required decades of painstaking development, but can be destroyed within a few years.

You then go on to say:

Current budgetary constraints are dangerously eroding that capacity. Thus Canada could be left without a research base at the very time when economic recovery will demand an increase in R&D activity.

So I understood your answer to my earlier question to be that Canada's research capacity was all right, and that there was not too much wrong with it.

Dr. Kates: I think the message here, senator, is that there are two problems before us. The first problem is, to what level should we grow, which we have discussed quite extensively. But the problem we are facing now is a hemorrhage problem, that is how to stop the hemorrhage of our scientific and technological capability. So what we are saying here is not to let it deteriorate any further. That is the message in that paragraph. We should at least maintain that which we have built up to date, and use it as a base from which to grow further.

Senator Carter: Are you saying that if we keep it at the present level, that is adequate.

Dr. Kates: No, we are not saying that at all. But under the present economic circumstances, at least let us preserve what we have. We acknowledge that there is a difficult economic situation, and we are not blind to that. But let us not, in order to make some small savings quickly, allow that base to erode any further. That is the message here. Then when the economic situation improves, it is to be hoped that we can build up from there to greater heights.

Senator Carter: Dr. Fortier referred to the situation in the universities, saying that there was a lack of funds, a lack of personnel and a lack of training because of the general shortage of funds. Are there any other university spots or any other industrial spots that are suffering?

Dr. Kates: Between ourselves, I have tried to highlight the industrial side and Dr. Fortier has tried to highlight the university side. As you have heard during previous hearings, the total R&D support in real terms has been going downhill. It has been worst for universities, and it has been "less worse" for industry and it has been "least adverse" for the governmental sector.

The Chairman: I think some members of the committee are ready now to accept my original proposal. I think that from now on we should proceed paragraph by paragraph, because I can see that some of these questions are referred to later in the brief. So, in order to avoid repetition and to have a more systematic discussion I think we should proceed now paragraph by paragraph. I have a question on paragraph 7. If others have questions on previous paragraphs, I am prepared to entertain them.

In paragraph 7, Mr. Chairman,—and this is not a very important question—but don't you think that when you say that the Science Council is a national advisory body on science policy, you are on rather shaky grounds legally and constitutionally? I say that because I am quite sure that legally and constitutionally you are a federal agency and not a national agency.

Dr. Kates: Mr. Chairman, in legal terms you are probably right and perhaps we should have checked with a constitutional lawyer. I think what we tried to convey here is that the attitude which the Council has adopted fairly early and which, by the way, has paralleled the Economic Council in its procedures as well, really stems from the following things; by the act, as we understand it, the council is given a great degree of freedom in its mandate; that particularly since the establishment of MOSST there has been clearly established an internal organization as part of the bureaucracy but on the other hand, as I pointed out previously, there is a very, very great external need. As a matter of fact, I do not think the Council could ever have done a very good job internally since it never had access to internal information within the government. Perhaps we should have said that the Science Council has adopted a national posture and that would have been more correct.

The Chairman: You are a federal agency with a national mission.

Senator Bourget: You can deal equally with the federal government and with the provinces. Is that what you mean?

Dr. Kates: Yes. We have no limitations and we found that the welcome mat was out for us wherever we travelled. We travel across the country and our people come from all parts of the country, and, as a matter of fact, we do not try to define ourselves as a particular federal body but we feel we are working in the national interest.

Senator Bourget: And your relations with the provinces are excellent?

Dr. Kates: Yes.

Mr. Shepherd: I might add, if I may, Mr. Chairman, that it is not only a question of federal-provincial, but it is also inter-sectoral.

Senator Godfrey: You advise industry as well?

Dr. Kates: Yes.

Senator Godfrey: With all due respect to our learned chairman, I do not want to get into an argument on semantics but I prefer the way it is laid down.

The Chairman: I was afraid that some of the people coming from the province of our vice-chairman here might object.

Dr. Kates: Just to give you an example, the last meeting—and I broke off a holiday for it—that Mr. Shepherd and I attended together was with 15 industrialists in Vancouver.

The Chairman: We feel here that we are part of the federal Parliament, but we also try to fulfill a national mission.

Anything else?

I have a question on paragraph 10.

Senator Bourget: In paragraph 8 the brief says:

We encourage, and have provided assistance for, the creation of provincial mechanisms for science policy development.

Can you elaborate on that? What kind of mechanisms would you suggest?

Dr. Kates: Well, perhaps Dr. Fortier would like to elaborate a little more on that.

[Translation]

Dr. Fortier: Those are precisely the responses that we have had recently from the Quebec Science Policy Council. In terms of assistance, this Council is only three years old and it is presently readjusting its staff and structures. It therefore has a relative experience in purely administrative aspects whose function is not yet fully defined or specified. We have answered the request of the Council's management to exchange opinions on our mutual missions.

Senator Bourget: Upon their request?

Dr. Fortier: Upon their request, on the reorganization of their agency and on the means or procedures for examining an efficient cooperation in carrying out the common objectives that we are trying to determine.

This is the type of cooperation that we tried to establish with other councils like the Manitoba Agriculture

Council with which we have done a more or less similar exercise. So, we aim at establishing a much closer and more fruitful cooperation.

Senator Bourget: It necessarily results in a better cooperation and avoids duplications.

Dr. Fortier: Certainly.

[Text]

The Chairman: Are there any questions on paragraph 9?

I have a question on paragraph 10. You state in that paragraph, Mr. Chairman, that the council has been assisting particular groups to define their positions and to make representations to the federal government. Can you tell us what kind of assistance has been provided to these groups? Is it grants or services?

Dr. Kates: No, it was services; basically, staff and sometimes council members would help these groups. I believe these were the foresters, agriculture, energy-modeling—we could give you a list of them. Basically I would say we have used our organizational writing and research knowhow in assisting these groups who did not have, perhaps, the resources or skills for doing it, to make their positions clear. I believe also that in the case of biology we were instrumental in having a rather fragmented situation, in which there were three separate groups, brought together, because it would be much easier for government and the scientists to have one group rather than three, which might be at cross-purposes. That is the type of assistance we have provided.

The Chairman: I believe you also indicate that you are treading on possibly dangerous ground in that respect, because you use public money to assist private groups to promote their own private interests before the government. I suppose, for instance, that the biologists will request more money from the federal government and that is rather dangerous ground these days, I suppose.

Senator Godfrey: Oh, I don't know; what's good enough for the Eskimos I am sure is good enough for the scientists.

The Chairman: I just wanted to point out that this might be a marginal activity for the council, rather than putting too much emphasis on it.

Dr. Kates: You are quite correct, Mr. Chairman; it is a marginal activity, but it is my belief that it is peculiar of the science and technology sector that it has not been a very able sector in this political arena. In my opinion, the lesson we must all learn is that decision-making in a democracy takes a certain form and if we desire the best for Canadian science and technology for the benefit of the country, then if we can help one another in becoming clearer, sharper and more effective in the political arena, we are helping the common cause.

The Chairman: I do not wish this to be used as a precedent by which we might see the Canadian Manufacturers' Association going to the Department of Industry, Trade and Commerce requesting a grant for the purposes of preparing their annual presentation to the government.

Mr. Shepherd: If I may react, Mr. Chairman, to the word "marginal", it is in fact almost central to the council's interests, in that we are attempting to achieve a coalescence of technical capacity within the country. Our interest is not to advocate a cause, but to achieve that kind of coalescence and it has been very successful in the energy sector with regard to the universities. We generally do not move out into the industrial sectors, but restrict our activities to the university faculties.

Senator Grosart: It is 10 minutes after 5 o'clock and we are at paragraph 11 out of 86 paragraphs.

Senator Godfrey: How long do you wish to continue, Mr. Chairman?

The Chairman: I would propose to continue until approximately 5:30.

Senator Grosart: Paragraph 11 deals with the lookout function, which is also discussed in paragraph 32, under "Technology Assessment". Does the council see any necessity for an organization in our national science policy decision-making process more like the Daddario Committee in the United States, or are we just *talking* about technology assessment? Would you suggest some mechanism or structure to bring it about? Everyone talks about technological assessment, and usually they just put it in the first paragraph and forget it.

Dr. Kates: In other words, an independent technological assessment body that can independently look at programs such as nuclear programs and so on. Yes, to some extent, of course, some of our own studies are technological assessment studies, as you will appreciate. The question is, should we have an agency such as that? I imagine what you have in mind, senator, is perhaps an agency reporting directly to Parliament, rather than to Cabinet. Is your question directed to that, as to whether this is something which we would advocate?

Senator Grosart: Precisely.

Dr. Kates: We are currently looking at the whole futures situation and we indicated to you that we would reply to your own futures questions at a later date.

The Chairman: There is a distinction, though, between futures study, which I understand that you will deal with later on, and paragraph 11, technological assessment.

Dr. Kates: Yes.

The Chairman: To look at the social and environmental costs and benefits. This does not relate necessarily to futures studies.

Senator Grosart: That is today.

Dr. Kates: We are saying that we ourselves are in a very good position to conduct as part of our mandate technology assessments of important problems. We have done it previously, are doing it now and intend to continue doing it in the future. I thought your question was whether we are recommending an agency similar to the technology assessment agency in the United States, which reports directly to Congress, rather than to the government. Of course, there is a different political system there and the answer to that question I would like to take under advisement, because we have not already discussed it.

Senator Godfrey: You refer to the varied backgrounds of the members. I referred to the composition of the council, and I am not quite sure what your profession is. I see you are listed as Josef Kates Associates, Inc. Are you a scientist yourself?

Dr. Kates: The headline in the press when my appointment was announced was "Non-scientist chairman of Science Council".

Senator Godfrey: Well, what is it?

Dr. Kates: I have a Ph.D. in physics, but I am also a professional engineer. After earning my Ph.D. I worked at the university for five years in a research capacity on computers. Since that time I have been basically in the consulting business: systems; computers; transportation; urban development; and what have you. Perhaps that headline supports one of your recommendations, which we are contradicting. You recommend that the council be known as the Science and Engineering Council. However, apparently the public or, at least, the press writer of that headline, feels that it is an entirely academic council, which of course it is not.

Senator Godfrey: It seems to me—and I believe this also bears on something brought out earlier by Senator Carter with regard to the public, and so on—that when I read the membership list of the council my impression was that it is overly weighted with people who are science-oriented. I have always been a great believer in such sayings as, "War is too important to leave to the generals!" Maybe science is too important to leave so overwhelmingly to the scientists. I do not believe there were any scientists on the Senate committee, yet they did a pretty good job. I felt the same way with regard to the Canada Council, which used to be divided into two groups—the arts, and the humanities and social sciences. When I went to the council no one was permitted to be in the humanities and social sciences group unless they were a product of the universities, which I thought was wrong. After approximately a year I managed to get some of the ordinary members of the council into that group. It just struck me, in going through this, that it is not quite as varied a background as you claim. You refer to the varied backgrounds and it struck me that it could be broader. I used to say that I represented the Philistines in the Canada Council.

The Chairman: In the Senate, also.

Senator Godfrey: That is correct; I have never been a conformist.

Dr. Kates: We fully agree with you. At the present time we are in an unfortunate situation. Half of the appointees to the council are supposed to come from the academic sector and half from the non-academic sector. Unfortunately, within one year we lost three of our members through death. So you can see that it is a rather dangerous occupation. The resulting vacancies and imbalances have not been quite balanced off. We ourselves are making recommendations to have more industrial appointees. Hopefully within the next six to nine months, as vacancies occur, the situation will be well balanced out.

This is not in the act itself. This has simply been a pattern. We find that half are academics. The non-ac-

demics are not all industrials. We have people like Mr. Seguin who is a television scientist, Mr. Ide, who is the head of the Ontario Educational Association. It might be best to have it one-third academic, one-third industrial, and one-third with some related background which is neither industrial or academic. I may be discussing that with Mr. Drury shortly, and, if he agrees, that is what we might strive for.

Senator Stanbury: I wanted to talk about paragraph 12, and perhaps 13. As a matter of fact, I am not sure that I am really talking about something that is dealt with in either of those paragraphs, because I think I am talking about something that I do not see in the brief but which has a good deal to do with the international situation we are in.

As we all know, for a good many reasons we are in the situation of a very serious balance of trade deficit at the present time, yet I happen to know of a number of substantial opportunities available to Canadian industry in the world that we are just not equipped to handle. I think Mr. Shepherd or Dr. Kates spoke a little earlier about the problem of the fragmented structure of Canadian industry. I appreciate that this is not exactly the subject of this discussion, but it is quite possible for Canadian industry, without very many changes in its present structure, to begin to be in a position to compete much better in world trade.

I wonder whether the council has had a look at world trade, the place that Canada might be playing in world trade, and has made any attempt to direct industry into research, along the lines of scientific research which would equip Canadian industry better to participate in international trade. We talk about health services, energy opportunities, and so on. We have such a tremendous opportunity, in my experience—from conversations, visits I have made to other countries, and my knowledge of the kinds of failures we have faced because of the weaknesses of Canadian industry in trade—to move out into the world, and I am not at all sure that anyone is giving industry any kind of focus in terms of the kinds of things they should be doing in a scientific research sense that would best equip them to move out into that world.

The Chairman: Senator, I will accept brief answers to your question, but I think this will come later on in our consideration of the brief. I understand that in this paragraph the council speaks about its own international relations so as to have an input from abroad, to help it to meet or serve its own mission. There are sections of the brief later on which deal with technology, interdependence and so on. I think it would be more appropriate at that time to raise these questions, which I agree are important.

Dr. Kates: The main work now underway is a study on further processing of Canadian raw materials; because we believe that if we add just a small increment to the total of further processing to which our exported raw materials are eventually subjected to anyway, therein may lie a large part of the answer to the balance of payments problem. We will probably be publishing a study, in the summertime, in about three or four months, on that subject. Our industry committee, which we have re-established recently, will be looking at other aspects of the problem you mention.

The Chairman: Are there any further questions on paragraph 12? In establishing this kind of network at the international level, do you have any precise arrangements with MOSST, so that there will not be any kind of duplication in establishing these relations; or do you think there is no danger of overlapping between the two agencies?

Mr. Shepherd: Mr. Chairman, in terms of cooperation, the head of the international directorate of MOSST is our ex-director of research. So there is an extremely close relationship on an informal basis. We tend to work with science policy institutions which may or may not be within a governmental structure. So that we are extremely satisfied that there is, in fact, no duplication, and, in fact, a great deal of cooperation.

The Chairman: Paragraph 13... 14?

Senator Grosart: I have one question. I think it takes in all the paragraphs to 17. I found your reports—both the ones you take responsibility for and the ones you disclaim responsibility for—excellent reports. Have you had any success with them? Can you point to any achievement, or change in policy, that has been brought about?

Dr. Kates: In the case of reports Nos. 4 and 15, I tried to give you the picture in my opening remarks of the extent to which government actions have paralleled our recommendations. We cannot, naturally, take entire credit for it. As a matter of fact, one of the problems we have, interestingly enough, is that our staff naturally have extremely close relationships with staffs in other government departments. They appear to be—

Senator Grosart: I was thinking more of the specific ones. Numbers 4, 6 and 15 were rather general. You had some very specific studies.

Dr. Kates: I believe, for instance, that the oceans program had a lot to do with our oceans report. The STOL Program, I happen to know personally, was very much influenced by our STOL report. So I would say that your success is never as high as you would like to have it, but it is not zero either. It is a difficult thing to measure. The way we are changing our posture, we hope to increase that success even further.

Senator Grosart: Do you have any mechanism for follow-up?

Dr. Kates: Not really. The information we get is what the general public gets. We do not get privileged information from government departments. We have to rely on information that is volunteered to us. Generally speaking, because our staff are here and have good relationships, by the grapevine we get a fairly good idea of the reaction to our reports, and to what extent they become a basic input, a building block, in the decision-making process.

As I say, in many cases we have found that the reason our report looks "old hat" by the time it is published is because some department has already picked it up and translated it into programs; so that it almost looks like our report is a bit of history.

Senator Grosart: Do you do any follow-up in the sense of pushing your proposals—a technological assessment of the worth or otherwise of your reports? Do you tabulate it? Can you say to me, "Here is what happened from the oceans report"?

Mr. Shepherd: May I present a specific example, not of an acquisition of intelligence as to what happened but what concrete activity we have taken to press a conclusion. Our latest report refers to the transfer of technology from government laboratories to secondary manufacturing. Eighty per cent of the recommendations in that document pertain to action that ought to be taken by the federal government. We have set up formal meetings with the Ministry of State for Science and Technology to ask them to pursue those through various government departments, to tell us which departments may require supporting arguments from the council, and what public constituency might need to be developed to encourage them in moving those recommendations. So that we have, in that case, evolved a very specific mechanism for pursuing recommendations through the federal administration.

Senator Grosart: That is a new departure?

Mr. Shepherd: Yes.

Dr. Kates: I might add, the general pattern we are developing is one which is much more open in that we are trying to involve the public, particularly the interested agencies, in our studies right from the beginning. This course, I think, will result in a greater awareness of the studies and will probably lead to a higher degree of implementation of recommendations.

The Chairman: The report you are now speaking of was published in December, 1975?

Mr. Shepherd: That is right, Mr. Chairman.

The Chairman: In the course of our inquiry, we might test some of your recommendations when we have officials of the various departments before us.

Mr. Shepherd: By all means, Mr. Chairman.

Senator Grosart: That is what we will be doing in the second round of our committee hearings. That is why I asked the question.

Dr. Kates: If I may come back to your observations respecting organizations, this report is very specific in that regard.

I should mention that Mr. Miedzinski was the Project Officer on this report.

Senator Grosart: We know him very well.

Senator Carter: Does the oceans program emanate from a report or recommendation of the Science Council, or was it initiated by MOSST?

Mr. Shepherd: It was recommended by an interdepartmental group several years ago that the council undertake a study on an oceans program. We did so with a great deal of cooperation on the part of the federal authorities, and out of it, by the way, recommended a specific crown corporation to stimulate ocean development. Hopefully, that may occur.

The Chairman: I propose we stop at paragraph 18. If there are no further questions on the previous paragraphs, I have one in relation to paragraph 16.

In paragraph 16, Dr. Kates, you say you intend to develop a more comprehensive look-out capability, as opposed to, presumably, a more specialized or study-by-study approach. How do you intend to develop that capability, and in relation to what? We understand at the moment that the Institute for Research on Public Policy is developing some kind of capability in this overall field, and that the Economic Council is also looking at this area. We further understand that various departments are planning to develop their own activities in this area.

Dr. Kates: Let me point out, first of all, that looking at the future in any field in which we are making a study, or producing a report, is, of course, something that we have always done. Also, in selecting the various reports or studies we undertake, we have to scan the overall situation in order to set our priorities.

What is intended here is, basically, a moderate effort to help us with our own selection of areas to study and to provide us with orientation in that regard. I do not think what is intended here is the duplication of what is being undertaken by the Institute for Research on Public Policy.

The Chairman: Are you a member of the institute?

Dr. Kates: As chairman of the Science Council, I am, I believe, an *ex officio* member of the institute

The Chairman: If there are no other questions, we will adjourn until next Wednesday, at which time we will again have Dr. Kates and his officials before us.

I can inform honourable senators that the Honourable Mr. Jamieson, the Minister of Industry, Trade and Commerce, is quite willing to appear before the committee, but is unable to do so before the Easter recess.

The committee adjourned.

APPENDIX "19"



Brief to the
Special Committee of
The Senate on
Science Policy

Submitted by
The Science Council
of Canada
February 1976

TABLE OF CONTENTS

	<u>Page</u>
A. <u>INTRODUCTION</u>	<u>5</u>
B. <u>THE SCIENCE COUNCIL OF CANADA</u>	<u>6</u>
Purpose and Mandate	6
Attributes	7
Roles	7
National Advisory	7
Public	7
Look-Out	8
International Awareness	8
Activities	9
Intentions	10
C. <u>CHANGES IN SCIENCE POLICY</u>	<u>11</u>
Transitions	11
The Years Ahead - Challenges and Opportunities	12
Technological Interdependence	12
Research Capability	13
Technology Assessment and Look-Out Capability	13
Opportunities in a Conserver Society	14
International Responsibilities	14
Major Programs	15
Scientific Expertise	16
D. <u>RECOMMENDATIONS OF THE SENATE COMMITTEE</u>	<u>17</u>
Comments on Volume 2	17
Organizational Structure of R & D	17
Levels of Support for R & D: Targets and Indicators	18
Arresting the Decline	18
Targets for Expansion	20
Industrial R & D	20
Comments on Volume 3	21
Parliamentary Committees	21
Ministry of State for Science and Technology	21
Other Government Departments	23
Scientific Societies	24
French Vocabulary	24
Science Council of Canada	25
E. <u>EPILOGUE</u>	<u>29</u>
Appendix I: ANNUAL REPORT OF THE CHAIRMAN (1974-75, by Roger Gaudry)	30

A. INTRODUCTION

1. This brief is in reply to the request, dated 17 September 1975, from the Chairman of the Special Committee of the Senate on Science Policy.

2. In this document we successively describe the current and projected role of the Science Council, review the major issues in science policy in Canada, and then comment generally upon the recommendations of the Senate Committee, contained in Volumes 2 and 3 of its Report.

3. The Council shares with the Committee a great concern for the development, use and status of science in Canada.* We welcome the opportunity to make our views known in the forum of the Committee's hearings. These hearings could hardly be more timely, or the subject more urgent and more closely related to issues of crucial national importance. Proposals to change the organization for the support of science in Canada lie dormant. Science and technology are accorded a low priority. Universities and many industrial sectors confront imminent crises. These developments make it imperative to speak clearly and act decisively, at this time. The Science Council believes that national and international problems and opportunities involving science are of such importance and urgency that:

- science in Canada must be strengthened to meet the challenge;
- the efforts of the "three solitudes" must be coordinated and a far more cooperative climate be encouraged;
- the understanding of the vital role of science and its needs, both by the public and by governments, must be increased sufficiently for science to be given a much higher national priority in order to bring social and economic benefits to Canada.

* To avoid unnecessary repetition, we shall often use the term "science" to stand for "science and technology", or "science and engineering", depending on the context.

B. THE SCIENCE COUNCIL OF CANADA

PURPOSE AND MANDATE

4. Sections 11, 12 and 13 of the Science Council of Canada Act define the Council's duties in some detail. However, the Act does not contain an explicit statement of overall purpose. At the Council's inaugural meeting in Ottawa on 5 July 1966, the Prime Minister stated this purpose:

"to give objective advice on science policy to the Canadian Government."

He also provided a working definition of science policy:

"decisions that determine the balance of our national scientific effort; the role of that effort in relation to our country's aspirations; its adequacy as to research on the one hand and applied use on the other."

Formally, the Act and the Prime Minister's definition require that advice be given to the federal government. However, the Act explicitly permits the Council, on its own initiative, or if directed to do so by the Minister, to

"conduct such studies, inquiries and other undertakings as may be necessary with respect to any matter ... relating to the carrying out of its duties [and to] cause to be published such studies and reports prepared for the use of the Council as it sees fit." (emphasis added)

5. The Council has interpreted these statements to mean that it is called on for advice from a national point of view - as distinct from an academic, industrial, provincial, or even federal approach. We have deliberately chosen to work in public and to publish our findings and, as often as practicable, to invite outside participation in our studies. We also believe that the best way to provide advice on an issue may often be through the stimulation of public discussion. Many of the issues on which the Council has to advise involve public and private bodies. Therefore we must communicate with these bodies, and may recommend changes in their activities or policies which are desirable from a science policy perspective.

ATTRIBUTES

6. While there are other institutions in Canada concerned with science policy, the Science Council is unique in combining the following attributes.

- It makes use of the talents and experience of both members and non-members through the work of Council and its Committees, thereby establishing links with the industrial, governmental and academic communities.
- It can treat any aspect of science policy with respect to all sectors of society across Canada.
- It is free to communicate with all sectors of society and with all levels of organizational hierarchies.
- It can publish findings on, comment on policies of, and make recommendations to, any public or private body.

ROLES

National Advisory

7. First and foremost, the Science Council is a national advisory body on science policy. The problems that we choose to study can be approached comprehensively, since we are not limited by jurisdictional and sectoral boundaries. For example, the Council is paying increasing attention to the decision-making processes in areas requiring the cooperation of several "parties" which may come from various sectors and jurisdictions. Such studies include assessment of needs and progress in a given field, and examination of current practices.

8. The Council is independent and can take non-partisan stances in working with different governments and different levels of government. We encourage, and have provided assistance for, the creation of provincial mechanisms for science policy development. We engage in dialogue with provincial science advisory bodies.

Public

9. Secondly, the Council has a strong sense of obligation to serve Canadians, especially in bringing to public attention the implications of science and technology, and bridging the gap between

experts and non-experts, decision makers and the public. It is, of course, easier to preach the need for public awareness and participation than to do something effective about it. We are not complacent about our accomplishments and are actively studying ways of improving performance. Many Canadians are interested in science and technology and have significant contributions to make.

10. As a particular facet of its role as a public body, the Council has acted as a facilitator in assisting particular groups to define their positions so that they may make appropriate representations, especially to the federal government. For example, we provided such assistance to the deans of forestry, agriculture and veterinary medicine and, most recently, to a group of biological societies. In this role the Council has scrupulously avoided becoming spokesman for any group in particular.

Look-Out

11. Thirdly, the Council can play an important look-out role in alerting society to emerging problems and opportunities. This is a difficult role to assume, since projections of the future tend to be distortions of features of the present. The varied backgrounds of our members allow us to pursue the look-out role effectively by identifying areas requiring technology assessment - namely an assessment of all social and environmental costs, as well as benefits, of an existing or proposed technology (as discussed in Background Study No. 30).

International Awareness

12. Fourthly, the Council is responsible for placing the development of a science policy for Canada in a global context. This is a vital dimension of our work and it is predicated on up-to-date information concerning developments on the international scene. (See Report No. 20.) As a corollary, the Science Council provides information about the science policy picture in Canada; it is a useful point of contact for correspondents and foreign experts.

ACTIVITIES

13. The activities of the Council for the period 1969-1975 are reviewed in Appendix II of this brief in the form of a response to the Committee's questionnaire, as requested (paragraphs 5 to 9, 21, 22 and Items 2, 3 and 5 of Appendix II). The additional comments below relate these activities to the principal roles of the Council.

14. The national advisory role of the Science Council is reflected in most of its recent studies. Report No. 15, Innovation in a Cold Climate, where a national perspective was given to the problems of Canadian manufacturing, is a pertinent example. A more recent example is provided by Report No. 23, Canada's Energy Opportunities. There is also in progress a study of the regulation of man-made hazards to health by involuntary exposure.

15. The importance the Council attaches to its public role is shown by the way studies are structured, particularly those in which there is a strong interaction between science and society. In order to stimulate public discussion during the course of studies, as well as after a Council statement has emerged, seminars are organized to obtain a wide spectrum of opinion. We are currently engaged in a public discussion on Northern Development before arriving at conclusions and recommendations. The follow-up activities associated with Report No. 22, Science for Health Services, are an example of the type of process the public is invited to participate in, once a Council Report is published. Several seminars were sponsored jointly with the Canadian Public Health Association and the report was discussed publicly by groups and individuals interested in health care delivery systems.

16. An appraisal of the future has become an integral part of Council studies and other activities, such as the recent initiative of mounting a set of international conferences on climatic change. However, we now believe, given the complexity of emerging issues, that the look-out function on a study-by-study basis is no longer sufficient. We therefore intend to develop a more comprehensive look-out capability.

17. Council and staff members have been exchanging perspectives on science policy with corresponding bodies in other countries and have established a network of relationships with individuals and organizations. These activities have included secondment of personnel. The Council has published a statement of concern on the status of Canadian participation in international scientific affairs (Report No. 20).

INTENTIONS

18. Within its available resources the Council feels it can best serve by identifying directions which might usefully be taken by others. The Council should be an initiator of broad new concepts. In the past six months, we have been attempting to identify themes which might give general guidance to the thrust of Canadian research and development. For example, we are attempting to evaluate the implications of a consumer society; we intend to re-examine questions of technological interdependence and industrial strategy, and to develop indicators of the health of the Canadian scientific community. These themes should provide a consistent frame of reference for our future program.

19. Because of the increasing number of issues which fall within the purview of science policy, the choice of program becomes more difficult. The "Annual Report of the Chairman" for 1974-75 (see Appendix I) pointed to major changes which occurred between 1966 and 1975. We believe that equally important changes are likely to take place in the next ten years. We consider it imperative, therefore, to remain flexible in the determination of our specific objectives and the development of operational strategies. This will be assisted by the continuing rotation of Council membership and the turnover of staff to respond to changes in program. These practices, in conjunction with medium-term program planning, will enable the Council to remain a dynamic national institution which can play a valuable role in anticipating the future.

C. CHANGES IN SCIENCE POLICY

TRANSITIONS

20. A major issue in the mid-1960s was the need to establish priorities for science.* Another major issue, namely the relevance of Canadian science and technology and the aptness of its structures to national, social and economic goals, received particular attention from the Senate Committee. Since 1972, increasingly severe recession-al pressures have significantly affected science and technology activities in all sectors. Consequently, the support of science has become an issue of crucial importance, yet it has not attracted the national attention it warrants.

21. Although some improvements in science policy structures and in science and technology policies have been made over the last few years, we think that six critical weaknesses, already evident in the 1960s, remain to be remedied adequately.

1) Role of Science

22. The effective value of the support for R & D has been decreasing in the 1970s, indicating that the decision makers have not fully appreciated the arguments of the Council, of the Senate Committee and of the scientific community as a whole, as to the crucial contribution which science and technology can make to the future of Canada.

2) Major Programs

23. Concerted attacks on the major technical challenges which confront this country have not been adequately structured and launched. We refer specifically to challenges in the policy areas of Energy, Oceans, Transportation, Communications, Agriculture, and Housing.

* We repeat that we are using the term "science" to stand for "science and "technology or "science and engineering", depending on the context.

3) National Planning

24. National planning mechanisms, essential to the management of major programs and vital to an orderly approach to a future of decreasing options and sharpening constraints, have not yet been created or have not yet become sufficiently effective.

4) Industrial Strategies

25. There has been a major failure to evolve and implement a range of strategies for the various sectors of industry by which industrial innovative efforts might be enhanced. The federal and provincial governments have not succeeded, for example, in establishing coherent procurement and incentive policies, which are vital to an improvement of the innovative environment.

5) Contracting-Out

26. The contracting-out policy for R & D has not materialized on a scale sufficient to meet its objectives.

6) Attraction of Talent

27. Attraction of Canadian talent to the pursuit of major technological challenges has been largely inhibited by the absence of major programs and the lack of cooperation and understanding among the government, industry and university sectors.
28. While many of these deficiencies are not peculiar to Canada, they must be recognized and overcome. The Council and all those concerned with science and science policy must share this responsibility.

THE YEARS AHEAD - CHALLENGES AND OPPORTUNITIES

Technological Interdependence

29. Concern about economic domination has been revived in Canada and is likely to increase. Canadians are not as willing as they once were to leave the bulk of technological innovation in the control of multinational corporations whose interests may not coincide with national aspirations. There is also a growing appreciation of the cost of technological dependency. The development of Canadian corporate strength, particularly in sectors where technology leads to fundamental changes in human thought and action, i.e., transformative technology, should be accepted as being of paramount importance to the enhancement of our productive capacity and our innovative base.

(See Report No. 21.) Only when this has been achieved will Canada have control of key technologies and a proper base for dynamic international trading policies.

30. The same base will be needed to ensure that, in the necessary technological exchange with other nations, Canada can replace its present overdependence on foreign technology by true interdependence. True interdependence can in turn facilitate policies and trade agreements that ought to ensure:

- complete freedom to market internationally technology developed domestically, and
- freedom to modify and re-export technology acquired from abroad.

Research Capability

31. The pressures of indigenous development of technology and of the selection and acquisition of foreign technology will place increasing demands upon Canada's capacity for basic and applied research, which required decades of painstaking development, but can be destroyed within a few years. Current budgetary constraints are dangerously eroding that capacity. Thus Canada could be left without a research base at the very time when economic recovery will demand an increase in R & D activity. It is imperative that, in spite of the haste to transfer technological effort to market applications, an adequate level of support for research be sustained.

Technology Assessment and Look-Out Capability

32. Technology assessment is a cornerstone of science policy. It is most effective when applied to technologies which have not yet been implemented on a large scale, i.e., when oriented toward the future. For example, the Mackenzie Valley Pipeline Inquiry (the Berger Commission) has sparked a healthy debate on the costs and benefits of the pipeline project and even on the future of the North in general. This kind of comprehensive assessment will increasingly be needed to keep pace with the growing number, pervasiveness and scale of technological projects.

33. A comprehensive technology assessment is a lengthy process. Pressures to get on with the implementation of technological undertakings are often very strong. Thus the necessary time may not be available, unless such assessments are started early. The process of systematic formulation of science policy requires a look-out capability in order to create information about potential problems and opportunities well ahead of the time when decisions should be taken. The functions of a look-out capability will be discussed in the Council's response to the Senate Committee's questionnaire on Futures Research.

Opportunities in a Conserver Society

34. The consequences of the long period of exponential growth in global population, combined with the exponential growth in per capita production and consumption of the industrialized countries, are bringing society to a new understanding of the pressing need for the responsible management of resources and the protection of environment. Many Canadians now view Canada as a country with finite natural resources, and recognize that it has only a limited capacity to absorb waste. Science policy must therefore stress the development of alternative resources and technologies, and of flexible systems. Developing these alternatives will require contributions from scientists and engineers in all sectors of society. Implementing the new policies will offer significant innovative opportunity to the industrial sector. Systems and products offering economy of design, low energy demand and durability of operation will command substantial markets. Such developments should appeal to innovators who will be needed to bring about the economy of conservation.

International Responsibilities

35. As an affluent country, Canada must work toward reversing the growing disparity between the "have" and "have not" nations. In the long run, the most sensible form of aid will be that which stimulates the economic development of the have-not countries. Canada is among the world's leaders in the magnitude and progressiveness of its

international assistance programs - programs which are directed toward improving the economies of Third World nations. But there is more to be done: enhancing "self-help" programs now will reduce the overall burden in the future. Such programs often require major scientific and technological inputs.

Major Programs

36. In pointing to problems and opportunities amenable to technical solutions, science policy sets broad objectives for science and technology. However, channelling the growth of science and technology in given directions, without stifling the freedom necessary to promote creativity, is inherently difficult. A promising approach is to rely on attraction-by-challenge rather than on any attempts at direct control. In 1968 we recommended this approach in Report No. 4 (p. 29).

"The greatest concern of the Science Council is to see that the growth of science and technology in Canada is channelled in appropriate degrees toward specific broad objectives as they are defined.

"To permit this channelling it is proposed that most new undertakings in Canadian science be organized as large, multidisciplinary, mission-oriented projects having as a goal the solution of some important economic or social problem and in which all sectors of the scientific community must participate on an equal footing. This report refers to these initiatives as major programs.

"Major programs are not new to Canada and some successful examples, such as the atomic energy program, have contributed notable achievements in their fields. What is new in this policy is that these programs are envisaged as the principal instrument for the growth and development of Canadian science and technology.

"A most important, but by no means sole, reason for the major program approach to organization is that it seeks to provide a national focus for efforts aimed at solving national problems. Ideally each program will give cohesion to the efforts of all

levels of government, of industry and of the universities as they work toward a common goal."

37. The concept of major programs has received insufficient attention despite the Council's advocacy of the principle. Some exceptions are water resource management, a curtailed approach to the short take off and landing (STOL) system, the Communications Technology Satellite (CTS) Program, and a late start on the oceans program. Some of these barely meet our definition of major programs, as stated in paragraph 36 (underlined). Other large expenditures on science, such as project TRIUMF and the Hawaii telescope project, represent significant contributions to the development of science in Canada, but do not meet the requirements by which we wish to distinguish major programs from major projects. The coming period of major transition to the economy of conservation will increase the need for a major program approach if Canada is to be among the nations leading the transition rather than lagging behind.

Scientific Expertise

38. Canada's ability to cope with current and future problems depends on the availability of appropriate means and personnel to generate and develop scientific knowledge. Our educational institutions are facing severe financial constraints and people are less inclined to provide unquestioning support for the pursuit of scientific knowledge. A long-term policy of support of existing resources in our educational institutions is essential if we are to recognize and respond to opportunities and problems. In this connection, the 1977 federal-provincial conference on the financing of education may affect the future scale and patterns of university research activity. Whatever the outcome of the conference, the universities should increase their ability to cope with the changing conditions.

39. The issues of future national science policy, outlined in this chapter, must be considered as key elements of our overall social and economic framework. They can and will be addressed only when the Canadian people become convinced of their close relevance to such matters as employment, productivity, social welfare and social justice. Granted adequate support, the scientific community would be expected to respond to new challenges with the vigour and determination called forth by its responsibilities to society.

D. RECOMMENDATIONS OF THE SENATE COMMITTEE

COMMENTS ON VOLUME 2

40. The Science Council, in its Sixth Annual Report 1971/72, responded to the recommendations contained in Volume 2 of the Report of the Senate Committee. Thus the following review is limited to particular comments on some of these recommendations.

Organizational Structure of R & D

41. The Science Council and the Senate Committee clearly agree on the importance of good communications among the various disciplines of science ("horizontal" communication), and throughout the principal phases of scientific activity - basic research, applied research, development and application ("vertical" communication). Integration within a single administrative organization usually improves communication, but limits are imposed by the inevitable compartmentalization of very large organizations. Thus choices have to be made and organizational divisions placed somewhere within these boundaries. In its recommendations for restructuring the federal R & D activities into a Canadian Research Board, a National Academy of Research and a Canadian Industrial Laboratories Corporation, the Senate Committee favoured horizontal integration.

42. While recognizing the advantages of this approach, we believe that they will be outweighed by the disruption of vertical communication. Organizational divisions are most detrimental when they create barriers to informal and personal communication. Separating basic and applied research in terms of performance, funding, administration and physical location will inhibit much needed interaction between the phases of scientific activity. Moreover, distinctions between basic and applied research are arbitrary; compartmentalization would lead to protracted and unnecessary dispute. Also, centralization of government science in a few agencies would result in reduction, within the line departments, of scientific competence relevant to their missions. This, in turn, would affect the quality of programs needed to meet departmental objectives.

Levels of Support for R & D: Targets and Indicators

43. The Council and the Senate Committee agree on the need for a higher level of gross expenditures on research and development in Canada. The notion that this expenditure (GERD) should be increased from the present level of about 1.1 per cent of GNP to the target of 2.5 per cent of GNP by 1980 is open to debate.

44. Aggregate indicators of this type can be useful for retrospective international comparisons, when combined with an analysis of reasons for the differences shown by the indicators. Both the Committee and Council have used them in this way. However, the use of such indicators in a normative way, to establish a target for future expenditures on R & D is questionable. There is no practical way to determine, and show convincingly, what the optimum value should be. Decision makers tend to disregard uncertain targets. The normative use of aggregate indicators is therefore ineffective. We tried this approach, despite our reservations, in 1969 when we recommended to the Prime Minister that GERD reach 2 per cent of GNP by 1973. This recommendation was published in our Third Annual Report.

Arresting the Decline

45. It is well known that neither the Council's nor the Senate Committee's recommendations for expansion of GERD as a percentage of GNP were heeded. In fact, the effective value of support for R & D in many areas has been decreasing since 1972. This is not obvious, since R & D expenditures expressed in current dollars are, in general, growing with time. Researchers in the field know the true situation, as affected by inflation and the need for increasingly sophisticated methods and equipment. However, serious effort is required to establish the extent of the decline in the purchasing power of the research dollar. We have examined this area before, for example, in Background Study No. 6, but now this work could more easily be carried out by MOSST, in cooperation with the Department of Finance, the granting agencies and other relevant departments.

46. An approximate picture of the situation may, however, be indicated by looking at a few readily available figures. Information

provided by MOSST to the Senate Committee on 16 December 1975 in "Trends in Science Expenditures" shows that the federal expenditures on the natural sciences have been declining since 1972/73, when deflated by the Consumer Price Index (CPI). The extramural part of these expenditures, when deflated by the same index, has remained essentially constant since 1971/72. This might not look too alarming. Unfortunately, CPI is too optimistic and too general an index when applied to R & D expenditures.

47. A more specialized index has been developed by NRC and, for some years, by MRC. The figures received from these agencies show remarkable agreement. The NRC index shows that the buying power of the NRC grants budget was reduced by 27 per cent over the five years from 1971/72 to 1975/76. The same index may be applied to the federal extramural expenditures on science quoted above. The result is only approximate but should be much closer to the correct value than that obtained using the CPI. The cumulative difference between the two indexes over the five years in question is 14.3 per cent, giving the deflated value of the federal extramural expenditures in 1975/76 as 13.4 per cent below the 1971/72 level, a significant reduction. We should point out that the NRC index does not include the sophistication factor.

48. The most urgent task, therefore, is to halt the decline of the Canadian research potential. We strongly urge the following actions.

- The federal government should immediately make a firm commitment to increase effective research funding in Canada beyond the level existing in 1971/72.
- The dollar value of the support required for this purpose must be established by working out the inflation and sophistication factors appropriate to each area of R & D, since these are generally higher than the Consumer Price Index.
- The work of the three granting councils, ITC and Supply and Services Canada (SSC) on developing the appropriate inflation indexes should be expanded to maintain an up-to-date, cumulative set of indexes for budgetary purposes. MOSST should coordinate the process so that compatible results are obtained.

Targets for Expansion

49. What we have described in the preceding section is a minimum requirement. An increase in expenditures, perhaps to the level proposed for 1980 by the Senate Committee, will be required if Canada is to continue to rank with other industrial nations in the world. A close watch must be kept on comparative spending on research in different sectors, so that the capability within industry and the research expertise within universities are both sustained.

50. Any evaluation of the most appropriate level of funding should be based on the principle that the level and distribution of R & D is dictated by national goals. The task may be facilitated by separating the support for R & D into components:

- the level required to maintain the basic capability in each field of science, within each sector of society;
- additional support required in certain areas to meet the needs of specific missions in both the public and private sectors.

51. Well-documented statements by the various groups within the R & D community, which should be open to critical examination, can best determine the first component of support. Those in charge of the missions, in consultation with those who perform the R & D tasks, should determine the second component. An example of a step in this direction is the forthcoming national statement on biology in Canada, Tomorrow's Biology.

Industrial R & D

52. The Council agreed with the Senate Committee's views of the problems facing Canada's manufacturing sector, as those problems existed when the Committee's report was published. We also believe that the needs of resource-based industries and of service and construction industries must not be ignored. The resource sector accounts for 8.4 per cent of the labour force (10 per cent of our total industrial production). There are strong indications that resource-based industries will continue to play a major role in the Canadian economy, particularly as certain commodities become

increasingly scarce. Service and construction industries, which employ 64 per cent of the labor force, are growing faster than the other two sectors of the economy, but they have not made significant gains in productivity. Innovation is therefore as important for service and construction industries as for the other sectors.

COMMENTS ON VOLUME 3

Parliamentary Committees

53. The Council agrees with the Senate Committee that there is an obvious, urgent need for dialogue between parliamentarians and scientists. The past and present Hearings of the Senate Committee have contributed to such two-way communication; they have clearly indicated that a continuing exchange with both the Senate and the House of Commons is desirable. Scientific and professional societies should invite politicians to major meetings. Politicians should actively seek the counsel of scientific and professional societies. Most importantly, an active, permanent Committee on Science and Technology in the House of Commons, with adequate research staff, would help to sustain an on-going dialogue between the science community and legislators. There is also merit in the concept of an informal committee comprising members of Parliament (both Houses) and representatives of the scientific community.

Ministry of State for Science and Technology

54. The Science Council concurs that a strong Ministry of State for Science and Technology is fundamental to the development of an effective science policy at the federal level in Canada. We interpret MOSST's responsibilities to be advising the Cabinet, advising the Treasury Board, advising the Department of External Affairs, initiating policy formulation and program development (a coordinating role), and monitoring and reporting on federal government major programs and multidepartmental activities. A comprehensive discussion of the role of Ministries of State, with special emphasis on MOSST, was given in our Background Study No. 31.

55. As an agency of the federal government, MOSST needs to respond to immediate problems and thus is oriented to short- and medium-term issues. In addressing these problems, its role is to exercise influence rather than to wield power. In the vernacular, MOSST must have a low but distinctive profile.

56. There are several important roles for MOSST to play. It should be responsible for providing advice to Cabinet on the scientific activities being proposed or carried out by line departments. It should scrutinize the scientific components of line department budgets and render advice to Treasury Board. In ensuring that science items are accorded due budgetary consideration, MOSST officials should act as advisers to Treasury Board staff when the latter enter into discussion with line department officials.

57. Additionally, MOSST should initiate proposals, particularly proposals that encompass activities of several line departments. An increasing number of goals, policies and programs not only do not lie solely within the mandate of one line department, but are so broad that it can be difficult to give the lead role to one particular department. For example, the development and implementation of space, oceans and land use policies require the cooperation of a number of departments. In these situations, MOSST may initiate policy formulation, as they have already done for space and oceans. They must then coordinate the implementation of policy, and identify which of the various line departments should lead different parts of a program or a whole program.

58. Cabinet may also require advice independent from that received from line departments. For MOSST to play this role, it must be free of responsibilities accruing to line departments.

59. Quite apart from its role as a catalyst, MOSST can monitor the progress being made by line departments and alert Cabinet if coordination is not satisfactory. MOSST should be in the best possible position to detect unnecessary overlaps or gaps in scientific activities.

60. International scientific exchanges play an important role in Canada's external affairs. In this context, MOSST can influence attitudes and decisions among scientists and foreign service officers, and draw attention to scientific components of international affairs.

61. The budgetary role of MOSST is important and should be strengthened. A stronger role in budgetary matters could develop as MOSST gains experience. However, the future of the Ministry should not be as strongly predicated on a budgetary role as the Senate Committee has suggested. The formulation of policy for new or reorganized scientific activities, the initiation and coordination of programs involving more than one government department or agency, the continuing evaluation and assessment of current programs, the provision to Cabinet of scientific advice relating to social and economic programs, and liaison and consultation with agencies outside the federal government, are important functions of MOSST. All of them are necessary to the formulation of effective science policy.

62. To conclude, we would emphasize that the ability of MOSST to function effectively will depend almost totally on sustained support in the Cabinet. A low and distinctive profile, in which persuasion is the predominant characteristic, can only succeed when recognized by those with power.

Other Government Departments

63. The Council agrees with the recommendation that the Department of Industry, Trade and Commerce take strong leadership in the development of strategies for industry in Canada, but specific administrative arrangements, such as were proposed by the Senate Committee, should be the subject of a vigorous discussion.

64. The proposal that applied research and development for line departments might be done on a customer/contractor basis between government departments and government laboratories (the Rothschild approach) raises questions about the advisability of separating mission-oriented laboratories from their line departments. Developing strong governmental science and technology is not as easy as assembling a jigsaw puzzle of internal contracts. The experience of Great Britain in the next few years should be fully evaluated before such an approach is attempted in Canada. On the other hand, the principle of contracting-out as much government research as possible to industry and universities is certainly sound and is fully supported.

Scientific Societies

65. The Council agrees with the Senate Committee's advocacy of cohesive organization of the science and technology community in Canada. The Royal Society of Canada, which through its three "academies" (formerly "sections") embraces the natural sciences, social sciences and humanities, is vital to this purpose. SCITEC, which comprises most science-based societies and organizations, is equally necessary.

66. We should remember, however, that scientific and professional associations have one or more of three major functions. Firstly, they are entrusted with the development and diffusion of knowledge; accordingly, they promote meetings and symposia, create forums for debating issues, publish journals, and by other methods improve and maintain intellectual standards. In this function they fully deserve, for specific tasks, government support through implementation of the contracting-out principle (as recommended by the Committee). A limit for contracting-out is in practice set by the associated need for a project management structure which is not normally available within these associations. The second function of scientific and professional associations is to represent the interests of science and scientific professions to governments, public bodies, the media and the general public. This is not a function for which the Council would recommend financial support from public funds. There is every reason to expect scientists to make their case as part of their public duty. The third major function, pertaining to professional associations in particular, is that of licensing and professional control and is not relevant in this context.

French Vocabulary

67. The Senate Committee stressed the need for creation of a French vocabulary of scientific and technical terms, recommending that the federal government support the necessary action financially, and that international participation be invited. The Council agrees with this proposal and has participated in the development of the Service International de Terminologie Scientifique et Technique (SITEST). Recent initiatives in Quebec with respect to French terminology in general suggest that further federal action should be taken in cooperation with these initiatives.

Science Council of Canada

68. The Senate Committee report (p. 699) contains the following two statements:

"The Government does not need two frustrated advisory bodies. The Council's budget could be used by MOSST to strengthen the organization of the Canadian scientific community, which greatly needs it, and to commission from the stronger private scientific institutions the special studies it needs to advise the government.

"The Committee can see a useful role for the Council only within the framework of the strong central machinery for concerted planning and control that we have proposed. If the ministry is made responsible not only for policy but also for reviewing the science budget, then - but only then, we feel - there will be a need for an impartial outside critic of the whole decision making procedure."

69. The Council has not felt frustrated; neither has it seen itself as dependent on the future of MOSST. Moreover, the Science Council has been evolving a special role for itself. As we have already stated, the Council stresses its role as a national advisory body, concerned with industry, university, and all levels of government, and as much concerned with a policy for science as with science in policy. The Council sees itself as an impartial public agency that attempts to assist all sectors of Canadian society.

70. The Senate Committee report (p. 672) also makes five recommendations concerning the Science Council.

71. "That the name of the Science Council of Canada be changed to the Science and Engineering Council of Canada."

72. The Council disagrees with this recommendation. A name change would detract from the investment of the last nine years in establishing the reputation of the Science Council as it is currently known in Canada and abroad.

73. "That the Council be composed of a full-time Chairman and Vice-Chairman, one representing the physical sciences, the life sciences and engineering; the other, the social sciences and the humanities; and of 28 other members chosen from outside the public service of Canada."

Chairman and Vice-Chairman

74. There is no doubt that demands on the time of Chairman and Vice-Chairman could best be met by full time incumbents. Good people are available from industry and the universities to take such positions for a limited term. However, there are other important requirements which favour part-time positions. Independence, a crucial need, is certainly enhanced by a source of income and an established position outside the federal government. Also, continuation of employment outside the Council provides assurance against isolation. There is no ideal answer to this problem. The formal requirement that the Chairman and Vice-Chairman represent the physical and engineering sciences in one person and the social sciences and humanities in the other person might, at times, unnecessarily restrict the freedom of selection.

75. The Senate Committee has also suggested that if the Council had a full-time Chairman and Vice-Chairman the positions of Executive Director and Deputy Executive Director (now Director of Research) should be abolished (p. 671 of the Report). The Council is convinced that, irrespective of the decision with respect to the Chairman and Vice-Chairman, the need for an Executive Director and a Director of Research remains unchanged. The duties of the two pairs of positions are not overlapping, representing outward and inward orientations respectively. The distinction between the general responsibilities of the Executive Director and the much more focussed responsibilities of the Director of Research is also clear.

Government Members

76. The Council has opposed the recommendation that government members be dropped. There was no evidence of a conflict of interest on the part of government members, and their contributions were invaluable because of the experience and perspective they brought to

Council discussions. Furthermore, past experience has demonstrated that these members greatly enhanced the effectiveness of the Council by injecting their knowledge of Council studies into government agencies. Government membership is necessary simply because of strong government involvement in Canadian science. If the Science Council is to be "balanced", government members are certainly required. With the aid of these members the Council was able to provide links among the "three solitudes" so aptly described by the Committee. We regret the fact that these members have already been withdrawn by a Cabinet decision. The Council has continued to exercise its privilege of inviting government members to Council meetings when appropriate.

77. "That the ordinary members of the Council be appointed after consultation with appropriate representative organizations and on such a basis as to adequately represent the two main non-government R & D performance sectors, the main scientific and engineering disciplines, including the social sciences and the humanities, and the four broad regions of the country."

78. We agree with the spirit of this recommendation, but membership should not come solely from the two main non-government R & D performance sectors. Other sectors of society can have a profound interest in science and technology and, it could be argued, should have some representation on the Science Council. The experience of the Council has been that members are best chosen by attempting to reach an appropriate balance of expertise, background, and temperament, as well as regional representation. While this kind of informal recipe has not always produced an ideal mix, it seems inherently better than a more rigid formula. The membership of the Council needs to have strong links in the diverse social sectors and geographic regions. However, the predominant requirement for a strong Council is that its members think in terms of national interest. Deep understanding of regional or sectoral problems and points of view is helpful only as long as it does not lead to a narrow attention to the interests of special groups.

79. "That the terms of reference of the Council be interpreted as covering the social sciences and the humanities."

80. The Council has the responsibility to study and advise on ways of developing and using science and technology for the national benefit; it would therefore be unwise to carry out this responsibility without reference to the social sciences and humanities. The Council agrees with this recommendation and has been interpreting its mandate accordingly.

81. "That the Council, in the exercise of its broad function as an impartial observer, advisor, and critic of the formulation and implementation of science policy, maintain close liaison with the representative organizations of the Canadian Scientific and Engineering Community for the purpose of getting their considered views on the orientation and development of that policy."

82. We endorse this recommendation. The Council has established and will maintain close liaison with several representative organizations of the Canadian scientific community.

EPILOGUE

83. The problems facing Canadians today are complex and pervasive. Some are social and political; some are related to the kind of industrialization which prevailed in the past. A common denominator to these problems is the need or the want for more goods and services. There is no way to satisfy these needs and wants without much more industrialization. At the same time we know that the technology in the future will have to differ markedly from today's technology in order to conserve resources (energy in particular) and to protect the environment. Both objectives have to be achieved within the available economic resources.

84. Many of the necessary new technologies have yet to be invented, others need technical development combined with social innovation. Much of the scientific knowledge required for this purpose is not available today, nor do we have the understanding required to develop and guide the new social attitudes needed to accept the transition from a consumer to a conserver society. The time available for gaining new knowledge, changing attitudes and introducing new technologies is extremely limited - perhaps less than one generation.

85. If, as there are reasons to believe, current economic difficulties are not part of classical economic cycles but fore-runners of the end of the era of abundance in the industrialized countries, then we have a paradox. At the very time when there is a need to speed up new developments to overcome the current difficulties, these same difficulties are diverting priorities away from science and technology and eroding the effort for research and development.

86. With full recognition of these difficulties we must, therefore, call on decision makers not to belittle the promise of science and not to undermine our industrial base; both are indispensable to the provision of appropriate means for the well being of Canadians. The current generation of Canadians has lived better than ever at the expense of the future generations. If we care for those future generations - even if only for the next one - we have to use our intellectual capabilities and our natural resources to bring about a new lifestyle based on a conserver ethic. The Council accepts the challenge.

APPENDIX I.

ANNUAL REPORT OF THE CHAIRMAN (1974-75)

by Roger Gaudry

(NOTE: At the request of the Committee, the text of Appendix 'I' is not printed as it can be found in Science Council of Canada Ninth Annual Report 1974-75, pp. 27-45.)

APPENDIX II.

RESPONSE TO THE GENERAL QUESTIONNAIRE (1969-75)

Introduction

1. Since October 1968, the Science Council has become a Crown Corporation (cf. Amendment to the Science Council of Canada Act, 28 March 1969). Four appointments of associate members, representing departments or agencies of the government of Canada, terminated on 31 July 1973, by government decision; these appointments have remained vacant since then. New legislation is expected to increase Council membership to 30 in the near future.

2. The current membership of the Council is listed in the attachments to this Appendix (Item 1). Five positions are currently vacant and appointments are expected to be announced soon.

3. In pursuing its work, a Science Council Committee may, and usually does, contract out specific areas of research to individuals and institutions. The committees themselves are usually chaired by a Member of the Council and, on completion of a study project, background studies may be published. On the approval of the full Council, a report may also be published.

Organization

4. Item 2 presents an organizational diagram of the Science Council, and it describes the main divisions and sections of our activities. It also contains information about the current programs of the Council, in terms of both major studies and minor projects. The Council does not have formal links, organizational or otherwise, with foreign governments or their agencies. Neither is it constrained by formal links with Canadian industries or agencies.

Organizational Functions

5. The Council's role, organizational structure, and programs of activities evolve continually. The Council itself devotes considerable attention to its purpose and role and, for example, discussed this at a December 1975 meeting. However, since the Council

is a national body which emphasizes the public dimensions of its work, the most effective form of review is achieved by reference to public reactions to Council recommendations and activities.

6. Although slight changes in the Science Council of Canada Act are anticipated, major changes in organizational functions are neither probable nor desirable. The Council can now build on a nine-year-old foundation of individual projects. The national role of the Council, wherein the Council is identified as an institution concerned with the interests of all parts of Canada, and also as a body which focusses the thinking and activities of the science and technology community, will be emphasized more strongly in the future. In this context, the Council is not restricted to consideration of problems lying within federal jurisdictions. Also, in view of the increasing scientific interdependence of the developed nations of the world, the Science Council will have a special, national role to play as an interpreter of world trends and as the natural Canadian venue for the exchange of policy information.

Projects

7. Studies currently underway or completed in the recent past (see Item 5 for a list of past projects) range from considerations of policies in the area of transfer of technological know-how from government laboratories to manufacturing industries, and the need for concrete policies to deal with the problem of man-made hazards in the Canadian environment, to how science and technology can respond to population changes in Canada, and the role of science and technology in a "conserver society". A list of completed studies and relevant publications is in Item 3.

8. A major thrust of the Council's work has been the assessment of scientific and technological resources in Canada, with particular reference to the potential of Canadian natural resources. Many reports and studies reflect this thrust. Science Council Report No. 23, Canada's Energy Opportunities, for example, examines the need for long-term R & D policies in the context of present and future energy supplies in Canada. Background studies and individual sections of the Council's Report assess the potential of fossil fuels,

hydro-electricity, fission energy, solar energy, geothermal energy, etc., and then go on to describe technical difficulties and opportunities in developing energy sources for Canada and, in some instances, the world. Other studies have concentrated on institutional and organizational problems affecting the efficient deployment of technical and scientific resources in the country. Our Report No. 24 examines some of the communication difficulties preventing effective transfer of innovative techniques from government laboratories to the manufacturing sector.

9. At the Council's meeting in Winnipeg on October 2 and 3, two major studies were approved. A committee established to study man-made hazards will consider industrial, technological, and jurisdictional problems. Also timely is an extensive examination of Canada's food system, which will concentrate on ways and means to respond more positively to constantly fluctuating conditions.

Personnel Policies

10. The nature of the studies adopted by the Council is the chief determinant of staffing procedures. Since the Council's main program typically consists of five or six major studies lasting, on average, two years, and since there is no necessary connection between the substance of a study and the one preceding it, there is considerable need for staff changes or for staff adjustment to program changes.

11. Science advisers have the following duties:

- to participate in preparing proposals for new studies;
- to manage the background research program required in any study under the general advice of a committee of Council;
(The management at this level involves determining an appropriate research strategy and finding and dealing with appropriate consultants. In rare instances, a science adviser may perform some or all of the background research necessary for a given study.)
- to analyze the results of background studies and to prepare draft reports for the consideration of a committee and the Council;

- to prepare background studies for publication, to write articles, to deliver speeches, and to make contacts with members of the scientific and industrial communities.

12. There are 14 science advisers on the staff of the Council at present: 7 are permanent public service appointments; 5 are on renewable term appointments of one or two years duration; 2 are on secondment from other agencies.

13. Advisers on secondment or short-term appointments are usually chosen because of their competence in the area of one or another current study. More permanent appointments require a broad base of experience which will permit an adviser to study such disparate subjects as, for example, policies for basic research, science and the health care delivery system, and technology transfer.

14. Science advisers are assigned to projects by the Director of Research; it is usual for more than one adviser to be assigned to each major study.

15. Candidates for the position of science adviser will need, ideally, training in both the natural and social sciences, or in engineering. The successful candidate is likely to have had some experience in science policy.

16. Appointment procedures involve relatively time-consuming public advertisements, dependence on the experience and contacts of people regularly involved with science policy in Canada, and follow-up on occasional, unsolicited applications.

17. The Science Council also seconds advisers to other organizations and agencies of government. For example, one staff member recently joined the Department of Energy, Mines and Resources for a one-year appointment.

Personnel and Scientific Activities

18. The Council currently employs 50 full-time people and 14 on fixed terms. There are five categories of personnel at the Science Council:

- | | |
|---------------------------------------|---|
| 1) Executive | - 2 DM (1/2 time service each) |
| | - 2 SX (full-time) |
| 2) Scientific and Professional | - 3 ES (2 full-time and 1 fixed-term on secondment from university) |
| | - 7 SE-REM (6 full-time and 1 on secondment from university) |
| | - 1 SO (full-time) |
| | - 1 LS (full-time) |
| | - 4 PM (full-time) |
| 3) Administrative and Foreign Service | - 7 AS (full-time) |
| | - 2 IS (full-time) |
| | - 1 PG (full-time) |
| 4) Technical | - 3 SI (full-time and 2 fixed term) |
| 5) Administrative Support | - 9 ST (full-time) |
| | - 11 CR (9 full-time and 2 fixed term) |

19. Six of the above-mentioned personnel devote most of their time to administrative duties. Tabulated information concerning professional staff associated with scientific activities is attached (Item 4). The estimated average distribution, according to degree categories, from 1969 to the present is: 6 bachelor's, 6 master's and 7 doctorate's. The proportion of current professional personnel who have been employed by industry at one time since graduation is 53 per cent; have been on the staff of universities, 53 per cent; have worked for provincial departments or agencies, 26 per cent; and have at one time or another worked for a federal agency, 68 per cent. The Senate Committee's questions relating to education, leave and university students on summer employment are not applicable to the Science Council's activities.

Expenditures Associated with Scientific Activities

20. The functions of scientific activities engaged in by the Science Council are not covered by the Senate Committee's questions. The scientific disciplines involved are many, and most areas of

application are in a different category from R & D institutions. The actual amounts spent for each of the fiscal years since 1969 are:

1969-70	\$ 1 148 840
1970-71	1 184 741
1971-72	1 339 369
1972-73	1 328 851
1973-74	1 582 586
1974-75	1 789 262
1975-76	2 119 000

Research Policies

21. Research policies at the Science Council, with reference to the duties specified in the Act, reflect the perceived priorities of science and technology in a national community which relies on the contribution which science and technology have made to the economic and social fabric. Projects are therefore selected by the Council, which comprises men and women whose experience reflects a wide knowledge of industrial techniques, university research, and social needs. Other federal agencies have a limited role to play in this process, but they have in the past suggested certain programs (e.g., Report No. 10, Canada, Science and the Oceans, was developed in response to the interest of the Canadian Committee on Oceanography, a government interdepartmental committee). There are many examples of ongoing cooperation, both in terms of the formulation of research proposals and the exchange of information necessary for a competent assessment of any given problem (e.g., staff members have contributed to the Economic Council's work on the construction industry).

22. Priorities set by the Council are reflected by the division of projects into major studies and minor projects. The attached organizational chart (Item 2) demonstrates that where the Council can provide a service by focussing the activities of, say, biologists in Canada, support is given and professional staff assigned. Full-scale studies, on the other hand, which often involve contracting-out and extensive consultation with experts in other agencies and throughout the country, are priority items and usually involve the publication

of background studies, as well as a final report addressed to the Minister of State for Science and Technology.

23. The Council is not a large organization, and studies can be effectively managed without the implementation of network methods such as the Critical Path Network or the Program Evaluation and Review Technique.

24. Contracting-out has always been an important source of competent background material in the development of Council studies. Two particular examples illustrate the role of this procedure: background studies on northern development have included several contracted case studies; all case studies for the recently announced project on man-made hazards in areas of scientific controversy will be contracted-out. The Council believes that in-house research should be the exception rather than the rule, but this policy is obviously constrained by cost factors.

Research Output

25. Since the Science Council is a national body, and since it has an independent advisory role, the success of its operations in the future will depend greatly on the extent to which its findings and recommendations are debated by government, industry, the science and technology community, and the general public.

26. Publications are distributed on request to individuals and agencies in addition to general distribution through Information Canada bookshops. Ongoing liaison with the popular and specialized press is another feature of the Council's programs, and there is extensive consultation with industry and other scientific institutions and policy organizations.

27. It is virtually impossible to quantify the impact of an advisory body. Council publications have certainly had their effect on government, and the policy advice given in background studies and reports has been utilized throughout the country. In some instances, wide debate has followed release of a Council publication. If every recommendation was implemented however, giving the Council a "100 per cent score", this would only mean that government was hearing what

the government wanted to hear. A list of projects undertaken by the Council is attached (Item 5), and current programs are indicated in the organizational chart. In addition to listing these items, the Council would emphasize its role in catalyzing concerted action, such as the national statements prepared on behalf of the Deans of Agriculture and Veterinary Medicine, and Forestry.

28. The Council takes care to maintain flexibility in its program. This permits it to change priorities and even to abandon projects already under way.

Conclusion

29. In concluding this response to the Senate Committee, we would like to point to three studies which demonstrate the variety of roles which it is possible for the Council to play. The first of these is a study of technological innovation in Canada. The background studies which eventually culminated in a Council Report (Item 5) illustrate the value of broad examinations of the context within which technological innovation has to work. The energy report (Report No. 23, Canada's Energy Opportunities), on the other hand, drew attention to a host of difficulties in the Canadian energy scene. At the same time that it emphasized the opportunities afforded Canadians by the wealth of its natural heritage, the Council was anxious to describe the technological limitations of resource development and especially the long lead times involved in most new ventures. Finally, a report on health care (Report No. 22, Science for Health Services) was intended chiefly to stimulate widespread debate and to encourage various facets of the health "sector" to meet, to talk and to consider problems and priorities. The health project is a particularly good example of the Science Council's activities in a decidedly public arena. We expect that the Council will continue to initiate debate in order to raise and clarify issues of public importance.

ITEM 1 - MEMBERS OF THE SCIENCE COUNCIL OF CANADA

Chairman

Josef Kates
BA, MA, PhD, PEng
Josef Kates Associates Inc.,
Toronto, Ontario.

Vice-Chairman

Claude Fortier
C.C., MD, PhD, F.R.C.P. (C), F.R.S.C.
Directeur,
Département de physiologie,
Faculté de médecine,
Université Laval,
Québec, Québec.

Members

David V. Bates
MD (Cantab), F.R.C.P. (Canada),
F.R.C.P. (London), F.R.S. (C)
Dean,
Faculty of Medicine,
University of British Columbia,
Vancouver, B.C.

A.A. Bruneau
BASC, DIC, PhD
Vice President,
Professional Schools and
Community Services,
Memorial University of
Newfoundland,
St. John's, Newfoundland.

A.C. Cagney
BSc
President and Chief
Executive Officer,
Hermes Electronics Ltd.,
Dartmouth, N.S.

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President and Vice-Chancellor,
University Professor,
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and Materials Science,
Affiliate of the Institute
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Research Associate,
Royal Ontario Museum,
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DEng, F.R.S.C.
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Executive Officer,
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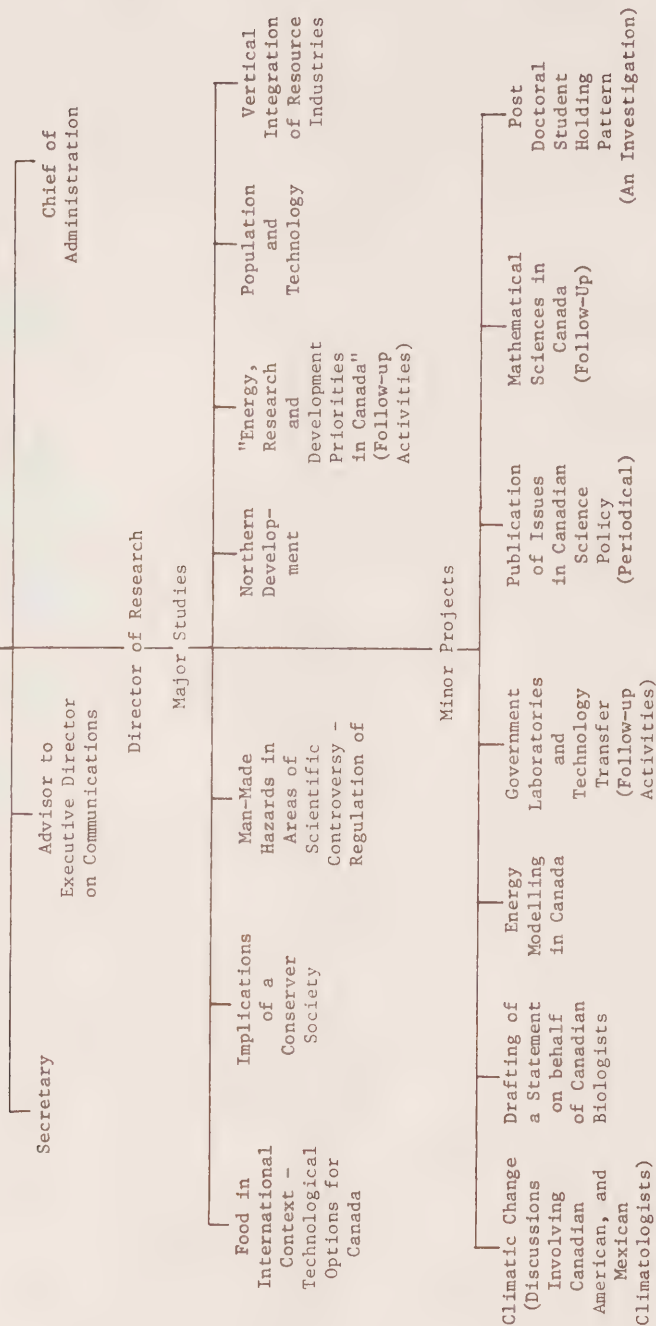
M. Vogel-Sprott
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Blossom T. Wigdor
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Dept. of Psychology,
McGill University;
Director of Psychology,
Queen Mary Veterans' Hospital,
Montreal;
Consultant in Psychology
to the Director General,
Treatment Services,
Department of Veterans Affairs.

ITEM 2 - ORGANIZATION

Chairman, Vice-Chairman
and 23 Members Appointed by the Prime Minister

Executive Director



ITEM 3 - LIST OF PUBLICATIONS

REPORTS

- Report No. 1 A Space Program for Canada, July 1967
- Report No. 2 The Proposal for an Intense Neutron Generator:
Initial Assessment and Recommendations, December
1967
- Report No. 3 A Major Program of Water Resources Research in
Canada, September 1968
- Report No. 4 Towards a National Science Policy in Canada, October
1968
- Report No. 5 University Research and the Federal Government,
September 1969
- Report No. 6 A Policy for Scientific and Technical Information
Dissemination, September 1969
- Report No. 7 Earth Sciences Serving the Nation - Recommendations,
April 1970
- Report No. 8 Seeing the Forest and the Trees, 1970
- Report No. 9 This Land is Their Land..., 1970
- Report No. 10 Canada, Science and the Oceans, 1970
- Report No. 11 A Canadian STOL Air Transport System - A Major
Program, December 1970
- Report No. 12 Two Blades of Grass: The Challenge Facing
Agriculture, March 1971
- Report No. 13 A Trans-Canada Computer Communications Network:
Phase I of a Major Program on Computers, August 1971
- Report No. 14 Cities for Tomorrow: Some Applications of Science
and Technology to Urban Development, September 1971
- Report No. 15 Innovation in a Cold Climate: The Dilemma of
Canadian Manufacturing, October 1971
- Report No. 16 It is Not Too Late - Yet: A look at some pollution
problems in Canada..., June 1972
- Report No. 17 Lifelines: Some Policies for Basic Biology in
Canada, August 1972
- Report No. 18 Policy Objectives for Basic Research in Canada,
September 1972
- Report No. 19 Natural Resource Policy Issues in Canada, January
1973
- Report No. 20 Canada, Science and International Affairs, April
1973
- Report No. 21 Strategies of Development for the Canadian Computer
Industry, September 1973
- Report No. 22 Science for Health Services, October 1974
- Report No. 23 Canada's Energy Opportunities, March 1975
- Report No. 24 Technology Transfer: Government Laboratories to
Manufacturing Industry, December 1975

BACKGROUND STUDIES

- Study No. 1 Upper Atmosphere and Space Programs in Canada, by J.H. Chapman, P.A. Forsyth, P.A. Iapp, and G.N. Patterson, February 1967
- Study No. 2 Physics in Canada: Survey and Outlook, by a Study Group of the Canadian Association of Physicists headed by D.C. Rose, May 1967
- Study No. 3 Psychology in Canada, by M.H. Appley and Jean Rickwood, September 1967
- Study No. 4 The Proposal for an Intense Neutron Generator: Scientific and Economic Evaluation, by a Committee of the Science Council of Canada, December 1967
- Study No. 5 Water Resources Research in Canada, by J.P. Bruce and D.E.L. Maasland, July 1968
- Study No. 6 Background Studies in Science Policy: Projections of R & D Manpower and Expenditure, by R.W. Jackson, D.W. Henderson and B. Leung, 1969
- Study No. 7 The Role of the Federal Government in Support of Research in Canadian Universities, by John B. Macdonald, L.P. Dugal, J.S. Dupre, J.B. Marshall, J.C. Parr, E. Sirluck and E. Vogt, 1969
- Study No. 8 Scientific and Technical Information in Canada, Part I, by J.P.I. Tyas, 1969
Part II, Chapter 1, Government Departments and Agencies
Part II, Chapter 2, Industry
Part II, Chapter 3, Universities
Part II, Chapter 4, International Organizations and Foreign Countries
Part II, Chapter 5, Techniques and Sources
Part II, Chapter 6, Libraries
Part II, Chapter 7, Economics
- Study No. 9 Chemistry and Chemical Engineering: A Survey of Research and Development in Canada, by a Study Group of the Chemical Institute of Canada, 1969
- Study No. 10 Agricultural Science in Canada, by B.N. Smallman, D.A. Chant, D.M. Connor, J.C. Gilson, A.E. Hannah, D.N. Huntley, E. Mercier, M. Shaw, 1970
- Study No. 11 Background to Invention, by Andrew H. Wilson, 1970
- Study No. 12 Aeronautics - Highway to the Future, by J.J. Green 1970
- Study No. 13 Earth Sciences Serving the Nation, by Roger A. Blais, Charles H. Smith, J.E. Blanchard, J.T. Cawley, D.R. Derry, Y.O. Fortier, G.G.L. Henderson, J.R. Mackay, J.S. Scott, H.O. Seigel, R.B. Toombs, H.D.B. Wilson, 1971
- Study No. 14 Forest Resources Research in Canada, by J. Harry G. Smith and Gilles Lessard, May 1971
- Study No. 15 Scientific Activities in Fisheries and Wildlife Resources, by D.H. Pimlott, C.J. Kerswill and J.R. Bider, June 1971

- Study No. 16 Ad Mare: Canada Looks to the Sea, by R.W. Stewart and L.M. Dickie, September 1971
- Study No. 17 A Survey of Canadian Activity in Transportation R & D, by C.B. Lewis, May 1971
- Study No. 18 From Formalin to Fortran: Basic Biology in Canada, by P.A. Larkin and W.J.D. Stephen, August 1971
- Study No. 19 Research Councils in the Provinces: A Canadian Resource, by Andrew H. Wilson, June 1971
- Study No. 20 Prospects for Scientists and Engineers in Canada, by Frank Kelly, March 1971
- Study No. 21 Basic Research, by P. Kruus, December 1971
- Study No. 22 The Multinational Firm, Foreign Direct Investment, and Canadian Science Policy, by Arthur J. Cordell, December 1971
- Study No. 23 Innovation and the Structure of Canadian Industry, by Pierre L. Bourgault, October 1972
- Study No. 24 Air Quality - Local, Regional and Global Aspects, by R.E. Munn, October 1972
- Study No. 25 National Engineering, Scientific and Technological Societies of Canada, by the Management Committee of SCITEC and Prof. Allen S. West, December 1972
- Study No. 26 Governments and Innovation, by Andrew H. Wilson, April 1973
- Study No. 27 Essays on Aspects of Resource Policy, by W.D. Bennett, A.D. Chambers, A.R. Thompson, H.R. Eddy, and A.J. Cordell, May 1973
- Study No. 28 Education and Jobs: Career patterns among selected Canadian science graduates with international comparisons, by A.D. Boyd and A.C. Gross, June 1973
- Study No. 29 Health Care in Canada: A Commentary, by H. Rocke Robertson, August 1973
- Study No. 30 A Technology Assessment System: A Case Study of East Coast Offshore Petroleum Exploration, by M. Gibbons and R. Voyer, March 1974
- Study No. 31 Knowledge, Power and Public Policy, by Peter Aucoin and Richard French, November 1974
- Study No. 32 Technology Transfer in Construction, by A.D. Boyd and A.H. Wilson, January 1975
- Study No. 33 Energy Conservation, by F.H. Knelman, July 1975
- Study No. 34 Northern Development and Technology Assessment Systems; A study of petroleum development programs in the Mackenzie Delta-Beaufort Sea Region and the Arctic Islands, by R.F. Keith, D.W. Fisher, C.E. De'Ath, E.J. Farkas, G.R. Francis and S.C. Lerner, January 1976

ISSUES IN CANADIAN SCIENCE POLICY

Issues 1, September 1974

Issues 2, February 1976

PERCEPTIONSVolume 1, Population Growth and Urban Problems, by Frank Kelly,
November 1975OCCASIONAL PUBLICATIONSA National Statement by the Schools of Forestry at Canadian
Universities, October 1973A National Statement by the Faculties of Agriculture and Veterinary
Medicine at Canadian Universities, 1975

ITEM 4
Professional Staff Associated with Scientific Activities (1975)

	(i) Birth Place	(ii) Country Secondary Education	(iii) Country Post Secondary Education	Average No. of Working Years	(iv) Average No. Years with Council	(v) Average Age	(vi) Bilingual Capability
BACHELOR	3 Canada 1 Britain 1 Rumania 1 Poland	3 Canada 1 Britain 1 Rumania 1 Poland	3 Canada 3 Britain 1 Germany	21	4.2	45	4/6
MASTER	2 Canada 1 U.S.A. 2 Britain 1 Italy	3 Canada 1 U.S.A. 2 Britain	4 Canada 1 U.S.A. 1 Britain	14	2.2	38	1/6
DOCTORATE	3 Canada 1 Australia 1 U.S.A. 1 Austria 1 France	4 Canada 1 Australia 1 U.S.A. 1 Austria	4 Canada 1 Australia 2 U.S.A.	15	2.9	43	3/7

ITEM 5 - PROJECTSPROJECTDATE-SPANREPORTS OR STUDIES

Space Program	May 1966/Jan., 1967	Study No. 1 - Upper Atmosphere and Space Program for Canada Report No. 1 - A Space Program for Canada
Physics - Discipline	Sept. 1966/May 1967	Study No. 2 - Physics in Canada - Survey and Outlook
Psychology - Discipline Assessment	June 1967/June 1968	Study No. 3 - Psychology in Canada
Intense Neutron Generator	Oct. 1966/March 1967	Study No. 4 - The Proposal for an Intense Neutron Generator: Scientific and Economic Evaluation Report No. 2 - The Proposal for an Intense Neutron Generator: Initial Assessment and Recommendations
Water Resource Research	May 1967/Sept. 1968	Study No. 5 - Water Resources Research in Canada Report No. 3 - A Major Program of Water Resources Research in Canada
Science Policy - Preliminary to National Statement	1967/Oct. 1968	Study No. 6 - Background Studies in Science Policy: Projections of R & D Manpower and Expenditure
Science Policy - National Statement	1967/Oct. 1968	Report No. 4 - Towards a National Science Policy for Canada
University Research	1967/1969	Study No. 7 - The Role of the Federal Government in Support of Research in Canadian Universities Report No. 5 - University Research & the Federal Government
Scientific and Technical Information	Mar. 1967/Sept. 1969	Study No. 8 - Scientific and Technical Information in Canada Report No. 6 - A Policy for Scientific and Technical Information Dissemination
Chemistry - Discipline Assessment	Nov. 1966/1969	Study No. 9 - Chemistry and Chemical Engineering: A Survey of Research and Development in Canada

<u>PROJECT</u>	<u>DATE - SPAN</u>	<u>REPORTS OR STUDIES</u>
Agriculture - Research and Economic Assessment	June 1966/Sept. 1969	Study No. 10 - Agricultural Science in Canada Report No. 12 - Two Blades of Grass: The Challenge Facing Agriculture
Industry - The Innovation Process	1967/1968 (done at the Economic Council)	Study No. 11 - Background to Invention
Aeronautics - Research and Economic Assessment	June 1968/1970	Study No. 12 - Aeronautics - Highway to the Future
Earth Sciences - Research and Economic Assessment	Sept. 1968/1971	Study No. 13 - Earth Sciences Serving the Nation Report No. 7 - Earth Sciences Serving the Nation - Recommendations
Forestry - Research and Economic Assessment	Feb. 1969/May 1971	Study No. 14 - Forest Resources Research in Canada Report No. 8 - Seeing the Forests and the Trees
Fisheries and Wildlife - Research and Economic Assessment	1970/1971	Study No. 15 - Scientific Activities in Fisheries and Wildlife Resources Report No. 9 - This Land is Their Land
Marine Sciences - Research and Economic Assessment	1968/1971	Study No. 16 - Ad Mare: Canada Looks to the Sea Report No. 10 - Canada, Science and the Oceans
Transportation - Model Assessment	Aug. 1967/1970	Study No. 17 - A Survey of Canadian Activity in Transportation R & D Report No. 11 - A Canadian STOL Air Transport System - A Major Program
Biology - Discipline Assessment	June 1967/June 1971	Study No. 18 - From Formalin to Fortran: Basic Biology in Canada Report No. 17 - Lifelines: Some Policies for Basic Biology in Canada

<u>PROJECT</u>	<u>DATE - SPAN</u>	<u>REPORTS OR STUDIES</u>
Industry - Innovation Support Structure	Feb. 1970/June 1971	Study No. 19 - Research Councils in the Province: A Canadian Resource
Highly Qualified Manpower	Nov. 1969/Jan. 1971	Study No. 20 - Prospects for Scientists and Engineers
Basic Research	Sept. 1969/June 1971	Study No. 21 - Basic Research Report No. 18 - Policy Objectives for Basic Research in Canada
Industry - Innovation Support Structure	Nov. 1969/June 1971	Study No. 22 - The Multinational Firm, Foreign Direct Investment and Canadian Science Policy Report No. 15 - Innovation in a Cold Climate
Industry - Innovation Support Structure	Sept. 1969/July 1972	Study No. 23 - Innovation and the Structure of Canadian Industry Study No. 26 - Governments and Innovation
Pollution	Spring 1971	Study No. 24 - Air Quality - Local, Regional and Global Aspects
Science-Based Associations	July 1971/Oct. 1972	Study No. 25 - National Engineering, Scientific and Technological Societies of Canada
Resources Policy	1971/1973	Study No. 27 - Essays on Aspects of Resource Policy Report No. 19 - Natural Resource Policy Issues in Canada
Highly Qualified Manpower	Nov. 1969/June 1973	Study No. 28 - Education and Jobs...
Health Care	Sept. 1969/Mar. 1972	Study No. 29 - Health Care in Canada: A Commentary Report No. 22 - Science for Health Services
International Science	June 1972/Apr. 1973	Report No. 20 - Canada, Science and International Affairs
Computer Applications	Jan. 1970/Sept. 1973	Report No. 13 - A Trans-Canada Computer Communications Network: Phase I Report No. 21 - Strategies of Development for the Canadian Computer Industry

<u>PROJECT</u>	<u>DATE - SPAN</u>	<u>REPORTS OR STUDIES</u>
Urban Development	1969/June 1971	Report No. 14 - Cities for Tomorrow
Technology Assessment	June 1972/June 1973 May 1974/Sept. 1974	Study No. 30 - A Technology Assessment System... Study No. 34 - Northern Development and Technology Assessment Systems...
Ministry Assessment	Sept. 1973/April 1974	Study No. 31 - Knowledge, Power and Public Policy
Industry - Technology Transfer	Oct. 1972/Feb. 1974	Study No. 32 - Technology Transfer in Construction Report No. 24 - Technology Transfer: Government Laboratories to Manufacturing Industry
Energy	Sept. 1971/Mar. 1975	Study No. 33 - Energy Conservation Report No. 23 - Canada's Energy Opportunities



FIRST SESSION—THIRTIETH PARLIAMENT
1974-76

THE SENATE OF CANADA
PROCEEDINGS OF THE
SPECIAL COMMITTEE OF THE SENATE ON
SCIENCE POLICY

The Honourable MAURICE LAMONTAGNE, P.C., *Chairman*

Issue No. 9

WEDNESDAY, APRIL 7, 1976

Ninth Proceedings on:

The Study of Canadian Government and
other expenditures on scientific activities
and matters related thereto.

(Witnesses: See Minutes of Proceedings)



THE SPECIAL COMMITTEE OF THE
SENATE ON SCIENCE POLICY

The Honourable Maurice Lamontagne, P.C., *Chairman*

The Honourable Donald Cameron, *Deputy Chairman*

and

The Honourable Senators:

Asselin	Hastings
Bélisle	Hicks
Bell	Lang
Blois	Manning
Bonnell	Neiman
Bourget	Riel
Buckwold	Robichaud
Carter	Rowe
Giguère	Stanbury
Godfrey	Thompson
Goldenberg	van Roggen
Grosart	Yuzyk
Haig	

27 Members

(Quorum 5)

Order of Reference

Extract from the First Report of the Special Committee of the Senate on Science Policy, presented on July 10, 1975 and printed as an Appendix to the Minutes of the Proceedings of the Senate of that day, and adopted by the Senate on July 24, 1975:

"The Committee, therefore, recommends that it be authorized to consider and report on Canadian government and other expenditures on scientific activities and matters related thereto;

That the Committee have power to engage the services of such counsel and clerical personnel as may be necessary for the purpose of the inquiry;

That the Committee have power to send for persons, papers and records, to sit during adjournments of the Senate and to report from time to time; and

That the Committee be authorized to print such papers and evidence from day to day as may be ordered by the Committee."

Robert Fortier,
Clerk of the Senate.

Minutes of Proceedings

Wednesday, April 7, 1976
(18)

Pursuant to adjournment and notice the Special Committee of the Senate on Science Policy met this day at 4:00 p.m., the Chairman, the Honourable Senator Lamontagne, presiding.

Present: The Honourable Senators Bélisle, Bourget, Buckwold, Cameron, Carter, Godfrey, Grosart, Hicks, Lamontagne and Neiman. (10)

In attendance: Mr. Jacques W. Ostiguy, Chief of Administration.

The Committee resumed consideration of its Order of Reference dated July 24, 1975 relating to the study of Canadian Government and other expenditures on scientific activities and matters related thereto.

The following witnesses from the Science Council of Canada were heard:

Dr. Josef Kates,
Chairman;

Mr. John J. Shepherd,
Executive Director.

The witnesses answered questions put to them by Members of the Committee.

At 5:20 p.m., the Committee adjourned to the call of the Chair.

ATTEST:

Patrick J. Savoie,
Clerk of the Committee.

The Special Committee of the Senate on Science Policy

Evidence

Ottawa, Wednesday, April 7, 1976

The Special Committee of the Senate on Science Policy met this day at 4 p.m. to consider Canadian government and other expenditures on scientific activities and matters relating thereto.

Senator Maurice Lamontagne (*Chairman*) in the Chair.

The Chairman: I apologize for the delay in starting, and I hope that we shall not have any more such delays for the remainder of our hearings. I apologize to the witnesses, on behalf of the members of the committee.

I regret that Dr. Fortier, the Vice-Chairman of the Science Council of Canada, is sick and so is unable to be with us today.

The committee will recall that we were going paragraph by paragraph through the brief presented by the Science Council of Canada. We had suspended our discussion at page 10 of the brief, at the subtitle "Intentions." We are dealing with paragraphs 18, 19 and so on. Are there any questions on paragraph 18?

I should like to ask you, Dr. Kates, to elaborate on your statement in paragraph 18, under "Intentions," within the framework of the three major themes you have identified: the implications of the conserver society, the technological and industrial strategy, and the health of the Canadian scientific community. You outlined those three themes as being major matters of concern and interest for the council. How do you plan to attack this field of activity, and what kind of priority would you assign each of the three?

Dr. J. Kates, Chairman, Science Council of Canada: The conserver society study is one that has been under way for, I believe, approximately one year. It is a study in which we have already issued a number of publications. They are staff rather than council publications. I notice, Mr. Chairman, you have our most recent statement, "Toward a Conserver Society," in front of you. It is expected that the study will result in a more formal council report sometime in the future. It is a very active program of the council. The chair person is Dr. Ursula Franklin, who gained considerable prominence at the time of the problems with nuclear fallout, when, you may recall, she collected children's teeth to establish the problems of strontium 90. So this is a vigorous program.

We are trying to establish and to obtain a consensus that over the long run there must be a transition from the present consumer orientated to a conserver society. We are attempting to define what we mean by that and we are attempting to indicate the kind of transition processes that will have to take place.

The Chairman: Do you intend to go beyond this series of publications? I have several of them, including some

issues where you merely quote a number of experts in that field who are worried about the future of mankind.

Dr. Kates: Yes. We believe that this project is the principal, the key, project of council, and therefore we should contribute as much as we can, not only towards explaining the need for that society, what it is, but also—which, in my opinion, is the most difficult part of the whole situation—how we get there.

Personally, I am now concerning myself particularly with the energy conservation aspect of that, because this is a very immediate problem. You will probably find that in the fairly short-term future we will be making some comments and providing some suggestions concerning this particular aspect. I do not expect that we will let go of that topic until we have a fairly clear understanding of what Canada ought to do in order to gradually relate that to such a society.

The statement of concern mentions that you cannot provide a complete and total blueprint, that you can give certain indications of what must be done by government, by industry, and, most importantly, that public understanding must be created for that kind of need. So we will not create a total blueprint of a conserver society or a highly detailed plan of how to get towards it. We hope to provide considerable information that will help Canadians eventually to agree on this as a future goal, as a future prospect for society, and agree on steps that must be taken towards it.

As you will appreciate, Mr. Chairman, this is a highly controversial topic. Mr. Trudeau himself raised a fair storm when he mentioned the concept in his Christmas and subsequent speeches. We on council are actually deploring that the aspect of his speech that appeared to be directed to private enterprise completely obliterated the aspect that we have to bring into public debate—the importance of change, that we cannot indefinitely carry on with the present consumer society. We will try to make as strong a contribution as we can.

The Chairman: I hope you are not too afraid, in continuing this activity, that you will one day be identified too closely with the Club of Rome, or even with the new sin, that of being too close to Professor Galbraith, the new Confucius.

Dr. Kates: I have a feeling that councils like ours and committees like yours have to provide leadership to the public and keep at this problem. It is directly related to the problem of being a body that works in the future perspective.

Mr. John J. Shepherd, Executive Director, Science Council of Canada: Mr. Chairman, may I mention two very specific comments about the conserver society project? One is the absolute belief that the conserver society

is not an option but is a situation that is going to occur, so that we may as well plan for it as have it happen by accident. The second thing is that the council's entire endeavour is to bring this phrase from Buddhist philosophy to practical policies and practices. That is the intent of our program.

The Chairman: Would you now comment on the second theme?

Dr. Kates: Concerning industrial strategy, the status is as follows. We have had a very active industrial program until, I believe, 1971, or it could be 1972, which culminated in the publication of report No. 15 "Innovation in a Cold Climate," and quite a number of interesting background studies dealing with multinational companies, the part that R&D plays in different kinds of companies, and so on.

I think that for a number of reasons, after we had published "Innovation in a Cold Climate," which had an extremely strong and interested reception across the country, that particular effort of council did not continue. At that time the atmosphere was one in which we basically set up a committee to produce a report, and we then disbanded the committee. We now know better. We know now that the report should be the beginning of an effort rather than the end, and a certain amount of work is now concentrated on what we call follow-up programs, bringing these things into public debate and influencing decision making.

Anyway, that is what happened with the industrial committee. Quite a number of our other studies—the technology transfer project, for instance—was a direct outcome of the studies that led to report No. 15. The further processing of raw materials, which is a study that is now under way, is basically the bringing together of some of our industrial interests and some of our natural resource interests. We have had some computer industry studies, and we have had some other specific industrial studies.

One of my first acts, on assuming the chairmanship of the council, was to re-establish the industrial committee, which is now in the formative stages. It has held a few meetings on an informal basis, and discussions and staff papers are under way regarding the types of programs we might undertake. We have not yet formally decided on the type of industrial program. If it is your wish, Mr. Chairman, my staff can give you some idea as to what topics we will be considering. So the status of our industrial work is that it is being re-established, which is quite different from the status of our conserver work, which is well under way.

The Chairman: This committee has been quite interested in determining why the R&D effort in the industrial sector is so weak in comparison with that of other countries. We feel that unless it is improved, it could prove detrimental to the Canadian economy in the long term. We have not been able to determine from previous witnesses the reason for this R&D weakness, nor have we seen any systematic study as to the reason for the weakness.

I am pleased to see that the Science Council is giving priority to this theme or project, and I certainly hope you will deal with this particular aspect so that at least we

will have some kind of explanation for that particular weakness in industrial R&D in Canada.

Dr. Kates: We certainly intend to do so, Mr. Chairman. In a broad way, in report No. 15, of which I gave you an extremely brief synopsis in my opening remarks, we set out quite a number of the factors diagnosed at that time accounting for the weakness in industrial R&D in this country. I do not think there is much disagreement amongst the various sectors that these weaknesses do exist, and the industrial committee will take it from there. It is not our intention to re-examine the overall diagnosis, because, first of all, we have done so, and, secondly, I do not think there is much disagreement across the country about the diagnosis of the problems. My hope is that this committee will concern itself with the cure and what specific recommendations can be made to improve the situation.

Senator Carter: Mr. Chairman, I think you covered the question I was about to ask. I would like to follow it up.

I should like to refer to a press release of November 26, 1975, under the heading "Canadian Industry: The Key Sector for Improving Canada's R&D Strength?" I should like to read a portion of it and ask the witness to comment on it, following which I have a further question. The press release reads as follows:

... a comparison between Canada and some advanced OECD industrial countries (i.e. France, Germany, Japan, Netherlands and Sweden) indicated that Canada's industrial sector was the weak link in Canada's R&D capability. It was found that the total number of people engaged in R&D in the government and higher education sectors in Canada was, in 1971, 15.5 per 10,000 population, whereas the average figure for the above five OECD countries was 15.8. By contrast, Canada's industrial or business enterprise sector had a total R&D manpower of 8.5 per 10,000 population, whereas the above five OECD countries had an average of 25.8 per 10,000 population.

I understood you to say that the council is undertaking a study into Canada's weakness in industrial R&D.

Dr. Kates: We took a look at the relatively low participation in R&D in the industrial sector both in report No. 4 and report No. 15 and I believe the fact of the very low R&D effort in the industrial sector is well documented in report No. 15. We tried to understand why there was such a lack of participation by the Canadian industrial sector, why we have so little innovation, so little R&D in this country, and both the report and the background studies provide an excellent portrait of what the problems are.

I do not think we need to look at those statistics any further. If anything, with the reduced funding in the industrial sector today, they are probably even somewhat worse than was the case at the time we examined the situation. The real problem is in arriving at a solution to this weakness. In report No. 15, we recommended that all the instruments be used in overcoming this problem—that is, the trade, taxation and direct incentives instruments—and that they be applied in concert in the framework of major programs, which we listed. We also recommended contracting out, transferring out, and purchasing. We made a number of recommendations. The problem before us now is to become more specific in pinpointing

more directly what has to be done, and perhaps placing more emphasis on the previous findings.

Senator Bélisle: We had a group of witnesses representing defence production before our Foreign Affairs Committee yesterday, and our very able and learned witnesses were not able to say with certainty that we were keeping abreast of research in the area of defence. It was evident from the charts which were produced by those witnesses that we were losing ground in terms of selling defence equipment abroad.

Maybe you will say, "I am not interested in defence", but it is research and we have to make money somewhere. The witness did not seem to be too certain. I repeat that we were keeping abreast with other countries in research and technology in the other areas.

Dr. Kates: It is obvious we are not keeping up a balance of payment in manufactured goods. As we said last week, it has worsened in three years from a deficit of \$3 billion to a deficit of \$10 billion. Just about every high technology sector has been affected by this decline.

There is no doubt that R&D in industry has very serious problems. Specifically research program, as you have previously heard, have been discontinued and other programs which were supposed to take over from there, took over after a long delay and with some considerable uncertainty.

I was not present yesterday, but we are convinced that we are facing a very serious difficulty in this country relative to those matters which you are mentioning here.

Mr. Shepherd: I would like to speak to that matter, as a partial answer to the question.

The answer in part is contained in paragraph 25, where we refer to the need for coherent strategies in the country in relation to industrial innovation. The problem is that the departments generally tend to advance a particular departmental strategy, which is positive in itself but is not positive totally unless there is a coherence between those policies. I refer specifically to procurement policies from DSS; incentive policies from the Department of Trade and Commerce; contracting out policies from MOSST. Unless all of these achieve a coherence, then none of them works out in detail.

With regard to your comment on the defence industry, we are losing ground, technologically, in many areas, although we are still ahead in one or two. The problem with the defence business is that it is not generating an R&D percentage, as a major program, which can be used by industry to maintain any kind of competitiveness abroad. So, the irony is that we are beginning to spend billions on defence but are not containing within those billions an adequate percentage of R&D which can be disseminated to industry for the spin-off technology. That is why the decline is beginning to occur.

Senator Carter: I would like to continue along that particular line of questioning with regard to high technology. We have been told over and over again that Canada should concentrate on high technology in areas where we can do the best. One of the areas we have is communications. We are now faced with an energy shortage and there is an emphasis on mass transit.

I had a meeting the other day with the officials of the CNR, and their rolling stock is so dilapidated and de-

teriorated that it is going to take billions of dollars to even put it in working condition.

In the meantime we have developed in Montreal the technology of a train called the LRC "light, rapid, comfortable." I do not believe the government has put any money into it, but if so, very little. Here is a tremendous possibility for export to other countries, even to the United States. People have come here—for example, Amtrack people and—have investigated it and have shown an interest. However, we Canadians, and our government, seem to be oblivious to it altogether. How do you explain that?

Dr. Kates: First of all, when you are speaking of CN rolling stock, senator, I believe you are referring to two kinds of rolling stock which are relatively poor. One of these is the passenger rolling stock, and the other is the wheat rolling stock. In both cases, the reason for that situation is that these are pieces of business in which the railways are not making any money. However, in the remainder, you will probably find that their rolling stock is in pretty good shape.

However, the big problem with LRC, which is a piece of modern passenger equipment—and it is a fairly sound kind of equipment because it is an incremental development rather than a big jump—is that the government has been doing a lot of soul searching with regard to rail passenger policy. As you have probably learned, the government has announced that its policy is basically to look to the development of better services in the Windsor-to-Quebec corridor and hardly anywhere else. That corridor in theory offers some kind of market for that kind of rolling stock. I would imagine either that kind of rolling stock or the turbo type rolling stock will be employed.

The unfortunate thing here is that despite very large distances, Canada, because of its low population density, does not in fact offer a large market for rail passenger travel. This is an area that I happen to be fairly knowledgeable in. The market is fairly confined to our eastern areas. Therefore, the image that we might project does not translate in terms of a passenger rolling stock market, and that is why we have a weakness in that field.

Senator Carter: In the Quebec-Windsor corridor, where this new technology can be employed on a profitable basis, the CNR will have to expend, even to maintain present services, in the next four or five years something in the area of \$700 million to \$800 million. Here is technology that is developed in Canada which has export potential as well, and we do not seem to have any interest in it.

Dr. Kates: I suspect that the powers that be are brainstorming this one now. The policy seems to be going in that direction fairly slowly, and you may be concerned about the slowness in instituting services in that corridor which may very well lead to the purchase of this kind of equipment. Therefore, you may find some decisions being made in that specific regard.

Senator Carter: Are you making any recommendations in this regard yourself, on the council? Is the council exploring this?

Dr. Kates: Other than pointing it out in a general way, we have not specifically done so. While we had a trans-

portation committee, it did look, in the time frame of 1969 to 1972, at all kinds of transportation possibilities, market potentials, industrial involvement and so on, but it did not actually publish a report on this specific item. So, these discussions were just committee discussions. We did become very familiar with that problem.

The Chairman: Some of these questions, Senator Carter, will come out under the paragraphs starting at No. 23.

Senator Carter: I have just one further question in this regard. I have in front of me a table from OECD. It is headed "Research Performed in Industry." The heading of one column is the country, and the heading of the other column is the cost per member of the total team engaged in R&D, in thousands of dollars.

For Austria, the cost per member was \$7.3 thousand; Belgium, \$13.2 thousand; Canada, \$23.2 thousand; Denmark, \$12.4 thousand; Finland, \$11.7 thousand; France, \$14.8 thousand; Germany, \$15.5 thousand; Italy, \$13.7 thousand; Japan, \$9.9 thousand; Netherlands, \$14.5 thousand; Norway, \$12.2 thousand; Sweden, \$18 thousand.

The average of all these, excluding Canada, is \$13.9 thousand, and yet Canada is almost double, \$23.2 thousand per member. How do you account for that?

Dr. Kates: Our comparison, by living standards and per capita in Canada, and so on, would be much more comparable to the United States, where you find our costs per member of a team would be probably somewhat below the U.S., than to countries of a per capita income which is considerably below ours. That would be our explanation.

Senator Carter: Our problem is that we have a small proportion of our population engaged in it at a terrific cost per member.

Dr. Kates: You said \$22,000 for Canada?

Senator Carter: \$23.2 thousand.

Dr. Kates: That figure seems low. However, that is per team member, rather than including the technician, draftsman and so on. Generally speaking, you talk of costs in terms of per engineer or costs per professional scientist I would have expected to hear a figure of \$50,000 or \$60,000 rather than a figure of \$22,000, because the extra cost per key person is probably quite a bit higher now. It used to be \$50,000, when I last looked at it a few years ago. I would not be surprised if it were somewhere around \$75,000 or \$80,000 today.

That is sort of taking everybody, including secretaries and so on, and dividing them up. You then come up with a figure which gives you an average income level for that particular undertaking. In that way it does not surprise me. But I think you really do have to compare it with the United States and perhaps Sweden and other countries which have per capita incomes that are pretty close to ours.

Senator Carter: This is in industry, not in government.

Dr. Kates: It is the same thing in industry. In other words, you have to look at per capita income of a mix of engineers, technicians, draftsmen, engineering support staff, and then to that you have to add the machinery they are using. I imagine that figure includes some of the machinery or laboratory equipment which they are using.

If you do it that way, that figure is right, but it would be heavily influenced by the per capita income of those professions.

Senator Carter: Have you investigated the cost in Canadian government? I mean the similar unit cost or per member cost.

Dr. Kates: No.

The Chairman: Dr. Kates, with respect to paragraph 23 you say that:

Concerted attacks on the major technical challenges which confront this country have not been adequately structured and launched.

How would you elaborate on that criticism? How would you go about improving the situation?

Dr. Kates: I think Mr. Shepherd could give you an example in terms of one or two of those programs.

Mr. Shepherd: I wonder if I could use an example, Mr. Chairman, of the oceans program. This was a program calling for a variety of Canadian technologies to meet known Canadian opportunities in the oceans program. The Science Council reviewed this area in their report dated 1970. In 1973 an oceans program was announced with some declared objectives within it. In 1976 we are waiting for that program to achieve thrust and purpose. A great many individual projects within the program have been launched, but there has been no concerted—and that is the word we have used in this current presentation—attack on such a major program.

Our central criticism, and I think this is not just an attack on government since we all share responsibility for it, is that central to the announcement of these programs there should also be the rapid institutionalization of a responsible lead agency, which would have responsibility to act on behalf of the federal government, to concert or perhaps participate even with industry in the management structure, to define the priorities rapidly, to establish funding and to implement the program. A typical analogy is, for instance, the Energy Research and Development Agency (ERDA) in the United States, which has carried out those responsibilities and has done those things very rapidly.

So our problem, I think, is that we have the intelligence to attack the priorities but we do not rapidly institutionalize the program, as a consequence of which it languishes over the years and industrial interest then withdraws from it so that we never quite get a concerted program going.

It is our view, therefore, that we have to resuscitate the major programs, rapidly advise on which lead agency it is that should co-ordinate that program and get that program moving with the participation of industry rather than merely treat it as an in-house government program.

The Chairman: And that would apply possibly to universities as well.

Mr. Shepherd: Yes, senator. Our criticism is that that has not occurred, although we have seen one or two examples, in the atomic energy program, for instance.

Senator Grosart: Mr. Shepherd, you said "get the program moving with the participation of industry."

Mr. Shepherd: Yes.

Senator Grosart: Do you see any necessity for the participation of industry before we get it moving—that is, at the planning stage?

Mr. Shepherd: Yes, senator, I think that that is absolutely vital, and one of the problems we have had is that when we have developed plans we have announced them as finished vehicles, and industry may not even concur.

The other point is that since the plans develop late, industry has not got its posture in good shape in order to attack that program, and there is then frequently a complaint that Canadian industry cannot respond. So that the organizational vehicle that we set up for the national programs must include industrial participation at the planning and formulation and problem-forming stage.

Senator Grosart: The department does not seem to believe that. In fact, they have almost told us it is not their policy.

Mr. Shepherd: We are unpleasantly aware of that, senator.

Senator Grosart: So are we.

Mr. Chairman, in paragraph 24, the brief makes a distinction between mechanisms and strategies, and we all understand that there is such a distinction. What specifically do you mean by "national planning mechanisms, essential to the management of major programs and vital to an orderly approach," and so on? You say these have not yet been created.

Mr. Shepherd: Yes.

Senator Grosart: Is that not what we were saying in this committee five years ago?

Mr. Shepherd: Yes.

Senator Grosart: Do you see any improvement in the creation of these mechanisms or adequate mechanisms?

Mr. Shepherd: Let me just say, senator, that by "national planning" we do not mean "GOSPLAN". By a "national planning mechanism," we are aiming precisely at the public and private sectors operating together in the planning stage.

We saw a positive attempt to do this under the STOL program, in which we tried to establish a lead agency within government and tried to structure an industrial group which would participate with such a lead agency. To some extent that was very innovative and everyone has to be given credit for trying that. The problem is that it took unconscionably long to get the mechanism in shape, which resulted in a delay in the program and a loss of international market position. So we have seen one very innovative effort to do it, and there may be more, but they are not occurring sufficiently rapidly.

Senator Grosart: Why did it take "unconscionably long"?

Mr. Shepherd: Point one: Because it was hard to define the lead agency among the competing empires.

Senator Grosart: It was hard for whom to define it?

Mr. Shepherd: Hard for government to define the lead agency. But on the industrial side there was also a critical weakness, in that perhaps because of ownership considerations it was not easy to put together an industrial consortium that could operate closely and harmoniously enough to work with government, and the fault was on both sides.

Senator Grosart: How do we correct this? Because this seems vital to the very essential problem of national science policy.

Mr. Shepherd: The central strategy of the council is to advocate major programs, to define the kind of lead agencies that should be put into place, which would include an industrial component, and then perhaps to define the priorities as rapidly as possible and to persuade government to move; but it involves initiatives in both sectors, that is, not merely government but also the private enterprise sector. I believe that the handing of carrots—large programs which are going to be funded, if that can be achieved—will attract the necessary cohesion from industry.

The Chairman: Would you see MOSST playing an important role at the centre of these things, and trying to identify within the government organization the proper agencies?

Mr. Shepherd: Well, MOSST did advocate an oceans policy and was one of the agencies that was involved, and I think it might well have a responsibility to advise the government on which is the most appropriate agency, from the government point of view, to establish as a lead agency. It would have that advisory capacity and would be equipped to handle it.

Senator Carter: If you are going to depend on government to take the lead, would it not be better to have industry in on the planning, so as to get industry's ideas as to what should be done?

Mr. Shepherd: Yes, senator, but industry has to be sure that there is a program and that there is going to be funding, and under what conditions the funding is going to be placed.

Senator Carter: But what I am getting at is, should the decision be left completely to government as to which programs should go ahead and which should not? Should industry not have a say? Should they not be able to make their own case?

Mr. Shepherd: Our problem now is that generally, in the technology sectors, our industry is so fragmented that it is not capable of mounting such a concerted effort, and unfortunately, in many cases the initiative has to come from another sector. Our forecast is that you would rapidly get a coalescence of industry if they felt there was a serious program in the offing.

Senator Godfrey: I think it was about ten days ago that I heard about one program in connection with ice-breakers in the north. Now they are building one in Port Weller. That all came from a casual remark by the Minister of Science and Technology about its desirability. It was then taken up by someone in the industrial sector. They came up to Ottawa and sold the idea, and got great co-operation. Why can there not be more of

that sort of thing from industry? Why do you have to wait for Ottawa all the time?

Mr. Shepherd: What we are objecting to, senator, is that these things should not happen by accident, simply because a particular program happens to be discussed. The major program priorities should be announced, like the oceans program, a rough idea of funding and timing should be given, and there should be an invitation extended to industry to participate in the formulation of those major programs and the choosing of a method of handling them.

Senator Buckwold: The credibility of government is also a factor. I am referring to the cancellation of an initiatives program that was called, I believe, the Canadian urban demonstration program, which involved \$100 million.

Dr. Kates: Oh yes. I believe it was for the encouragement of innovative ideas.

Senator Buckwold: Well, it had a relationship to Habitat, and 14 projects were accepted. The government was asking for people to present ideas, and I think two of the projects that were accepted involved the solar heating of houses, for example. There was a wide variety of items, some of which were scientific and some not. There was tremendous response, but then the government suddenly cancelled out. Money became a problem, and we can understand that, but the reaction on the part of the scientific community, and the business community, was a pretty negative one. Would you have any comments on that kind of criticism of government?

Dr. Kates: Yes, I agree with you, particularly with regard to the urban area. Over the last ten years we have seen in Canada, frequently, particularly at election times, promises of programs and then, subsequently, either curtailment or outright withdrawal. In other words, it does appear that government has not been able to make up its mind. With such a large proportion of the population in Canada being urbanized, and so many of our problems being the problems of cities, there is the feeling in Ottawa that the federal government ought to play a stronger role. At the same time, partly due to political problems involving provinces and municipalities, and partly—and this is probably the larger part—the price tags that might be attached to such policies, there has been a lot of moving back and forth in this area. As you can appreciate, the municipalities, particularly, are very unhappy and very sceptical. This is true both in the housing area and the transportation area, and we would very strongly support the federal government making up its mind with regard to the role it wishes to play in solving urban problems, and in trying to stick with them.

Senator Buckwold: The program I referred to was not really concerned only with urban problems. It was an attraction to the scientific community to come up with ideas. This is why I am linking them together. There were some tremendously interesting submissions. What I am really raising here, Mr. Chairman, is the question of government credibility as a factor in so-called government leadership with regard to developing programs of scientific interest.

The Chairman: In paragraph 25 you refer to procurement and incentive policies, and you say that these

policies have not been very effective. As far as procurement policy is concerned, I do not think we have such a policy at the moment.

Dr. Kates: That is correct.

The Chairman: Insofar as incentives or grants are concerned, I am sure you are aware that there is a series of reviews going on at the moment with the object of trying to improve these incentives. Have you not made any study of incentives and how to improve them?

Dr. Kates: We made, as I mentioned at the last meeting of your committee, Mr. Chairman, the statement of elementary, common-sense ground rules dealing with how the process of restructuring these incentives should take place—namely, maximum communication with those who would be affected by them, smooth transitions from one to the other, rather than abrupt transitions, and so on; but we have, of course, made our recommendations on contracting out, which are being implemented, and we have made recommendations on transferring R&D from government laboratories to industry. These, we hope, are going to be implemented. These are examples of comments we have provided.

The Chairman: But we are being told by industry and by the Minister of State for Science and Technology that all these incentive policies, which are being weakened now, as a result of the austerity program, have not worked. They have cut IRDIA, for instance, because it was not really working.

Dr. Kates: I can only refer back to the principles I mentioned in my statement. One very important principle, which was discussed at the time I was on the industry committee, and with which I found absolutely every one of the members of the committee in agreement, is to have a maximum of initiative in self-administration being passed to industry. I contrasted with that the early industrial R&D incentives, which basically permitted industry to claim 150 per cent by way of tax incentives. According to people I talked to in industry they prefer that type of incentive a great deal to the type of incentive that would involve going through the very laborious process of having to apply and justify, often lengthy delays and so on. So, wherever possible, if you can put the onus for the initiative on to industry and only provide for them the criteria under which a program may or may not be permitted, then perhaps leave the government involvement to a checking up later on as to whether or not they have followed the rules, and they can refuse *ex post facto* tax credit or something like this—this I think is a very important principle. That is a general comment, especially in a country like this which is so spread out and diversified. These are very simple comments, but I do believe they reflect the position of the industrial committee of the council at the time I was on it.

Senator Grosart: How would such an incentive—that is, the self-generating corporate income tax incentive—operate in a situation where we have such a high level of foreign ownership? One of the criticisms at the time was that most of the money was going to non-Canadian industry.

Dr. Kates: Well, I have not attempted in the statement to completely design a new incentive. It was simply so

that the Department of Industry, Trade and Commerce, in reviewing it, could take note of those principles if they were not already aware of them. If, for instance, it was the objective of an incentive to particularly favour Canadian industry or to favour certain sectors of the industry or a certain size of the industry, that could be stated. It can be stated, "This is applicable to Canadian companies, or to Canadian-controlled companies, or to companies below a certain size or to companies in a certain sector." That can all be added to the incentive.

Senator Grosart: But this could almost destroy the effectiveness of the program, to limit incentives in industrial research and innovation to Canadian companies.

Dr. Kates: I don't know whether that should be so, senator. There is a good part of Canadian industry made up of smaller companies, and the feeling of those who have looked at the incentives has been that relatively large chunks of incentives have gone to large foreign subsidiaries, like in the industry I know best, the IBM, and Control Datas, to establish large complexes here. Many Canadians ask themselves to what extent these companies were really in any need, and could not those funds, which amounted to many tens of millions, be used to develop a stronger Canadian industry. I do not know of any reason why, if you announce the plans that had certain restrictions, either Canadian-controlled or fully Canadian owned or with Canadian participation—why that should not have good results.

Senator Grosart: But in terms of the overall objectives, would this not put you in the position of denying the benefits of this to the high technology projects which would mostly be in the activities' sphere of foreign countries? I am not against it. I am merely putting the question.

Dr. Kates: Let me talk of the computer industry, which I know well. In the computer industry we had over the last 15 years quite a number of opportunities in this country. Foreign industry was not that much ahead. I built computers before IBM built computers in this country. We have had lots of opportunities, and in our report we have advocated support for the creation of a Canadian mini-computer industry, and the application to the process industry of that mini-computer industry, and the incentive of the type mentioned restricted to that might very well result in that. Now you might say, "Well, computer industry, too bad, we've missed the bus." Just a few minutes ago we were discussing the conserver society. It is our belief that there will have to be a tremendous restructuring of industry, the processes, the way we design things, the kinds of goods and processes we design, and the government could announce incentive plans of the type we are discussing for the purpose of developing a strong conserver society-orientated Canadian industry. I think that is quite a practical thing to do. There is a tremendous challenge in recycling, there is a tremendous challenge in using less energy intensive processes, so I do think we have still large opportunities in this country to develop new industries, particularly in fields where industry is not yet advanced.

Senator Grosart: Would you limit this to the major technological or technical challenge that you refer to in page 23?

Dr. Kates: No, I have a feeling that one might put on a criteria to ensure that they are creative—that is to say that these incentives are used for viable purposes, but to some extent we advocate self-administered and self-motivating incentives. You have to put a very high degree of support to the innovator. If you have an innovator in this country who develops a company and his innovation does not follow some particular policy, yet he may become a very successful man and to some extent the incentive should be geared to supporting the innovator. That is, in almost any field in which he can develop a useful enterprise. We might have a government policy that might support certain industrial sectors, but if we have an innovator in some other sector and he can develop a viable business and he does some good for the country, we should not take a black and white attitude and say, "Let us only develop industry in those sectors; in those chosen sectors we may strategically put resources," but I have a feeling that we should have a pretty broad net of supports for the Canadian innovator who can prove the brains and the energy and the ability to develop something in any positive way, and some of those may be ways we never thought about.

Senator Grosart: Would you limit this type of incentive to the actual costs of innovation; and, if so, how would you define that?

Mr. Shepherd: Mr. Chairman, if I might offer an observation on this, one of the central criticisms of the incentive programs, particularly those administered by the Department of Industry, Trade and Commerce, has been that they tend to support, and that their justification is related to, the success of a particular project advanced by a particular corporation, and they have not addressed the wider problem which I think is the central one of how do you achieve corporate viability and sectoral strength. Because of that we have seen projects succeed and projects fail, and the viability of the corporation may or may not have been enhanced by that particular program. So we feel that the real thrust of those incentive programs should not be separated from the procurement practice and the other strategies that can be brought to bear, and that their focal point should be the success of the company and the success of that particular technology sector. So we tend not to separate a specific incentive and discuss its advantages and disadvantages, but we try to lay the stress on corporate viability and what range of measures are needed to enhance that particular corporation.

Senator Grosart: Are you saying that you would apply the tax incentive to all the profits of such a company in a particular year?

Mr. Shepherd: Yes, and it has also been suggested, though not by the Council, that because of the tremendous amount of incentives that have been going to the large multinationals that we should set a limit, a corporate sales limit, beyond which those incentives would not apply. That limit would be set to achieve a high rate of growth for the medium and large technology corporations. The number was approximately \$200 million per year. Anything below that number should be subject to a range of incentives. Anything about the corporation could probably find its own innovative investments.

Senator Grosart: Are you really saying, if I may rephrase it this way, that you do not see such a program limited to Canadian companies, generally speaking to new Canadian companies and, third, to companies whose almost entire effort is in the area of the particular innovation?

Dr. Kates: I do not believe, senator, that is specifically true, and I would like to correct something which may be misinterpreted in the record. I believe you asked Mr. Shepherd whether it would apply to all the profits of a large company.

Senator Grosart: I said, "of such a company," meaning the specific type of company when you come to that definition.

Dr. Kates: I think we should be very careful that at a meeting such as this we do not attempt to design an incentive plan. We should discuss principles and we should say that the principles could be applied to favour certain kinds of companies, or certain particular projects and so on. However, I do not believe we should try to say specifically that it should be done for this and not for that. In other words, if as national strategy we wish to favour Canadian companies in our incentive policies over foreign companies, or favour small companies over large companies, we are saying that this can be done. However, this is not an appropriate forum in which to endeavour to design a particular incentive policy. These things are possible and they could achieve the results at which you are aiming.

Senator Gosart: The trouble with that, sir, is that we have all been talking general principles, including those who have been paying no attention to them, and it seems that it is quite the opposite. If we are going to do anything worth while here, we are going to design or suggest a mechanism as well as a strategy. If we do not do that, I do not think it will be done, because we have been discussing this, so have you in the Science Council, and most recently making general suggestions as to broad strategy. I should not say that nothing comes out of that, but the level of success has not been high on the mechanism side.

Dr. Kates: I quite agree with you, senator, but I am only saying that in preparing questions and answers I do not wish to say, let us have a tax disincentive whereby one would give 100 per cent cost allowance to a company of a certain size in a particular sector. Certainly, when it comes to that we may very well study that and come up with certain recommendations. Therefore, all I try to indicate is that the type of principles we have indicated in our statement ought to be applied in order to maximize the initiative of the private sector and minimize delays, red tape and other hindrances to getting an innovative program rolling. By this example we also tried to indicate that we can move this kind of incentive any way we please toward national purposes.

The Chairman: When the Minister of Science and Technology was before us we suggested to him that when the government has come to certain conclusions as a result of making reviews of incentive programs at the moment, rather than announcing government decisions, he should publish some type of white paper, blue paper or green paper which would be available to the public,

including industry, government agencies, your council and our committee, which would give us an opportunity to make an input to these new government programs. Would you favour that?

Dr. Kates: Yes. There is a big problem, that there is not much debate between the private sector and the government sector concerning what might be termed overall strategy. Most of the communications seem to be with respect to specific problems of specific companies or specific sectors. So bringing this into the public debate by means of a blue or green paper would be a commendable way to move it.

Senator Grosart: Representatives of the Department of Industry, Trade and Commerce have told us that they are at the moment in the process of structuring a new strategy for industrial innovation. Have you been consulted?

Dr. Kates: No, but I did meet with Mr. Stoner a few weeks ago and he offered to brief our new industrial committee as to what is happening. We might accept that offer soon.

Senator Grosart: Will he brief you on what has happened, or on what might happen?

Dr. Kates: His offer relates to what is going to happen. I understand that there is in existence a one-man review on industrial incentives. I believe Mr. Shepherd has had contacts with respect to the program. Do you wish to add to that?

Mr. Shepherd: We have had informal contacts when draft positions were under consideration, but there has been no formal contact with the council.

The Chairman: But they say in their brief that they have now an industrial strategy by sectors. They refer in their brief to a memorandum which has been approved by Cabinet, and so on. Yet here you say that there has been a major failure to evolve and implement a range of strategies. Are you referring to the past?

Mr. Shepherd: There was an original thrust toward a total industrial strategy. That was then switched by a quite wise decision to handle it by individual sector strategies. Some have been completed and some are in the formative stage. We have stated here that we consider their absence to be deleterious to industry.

The Chairman: Another element of industrial strategy, which is not mentioned here but which we have also discussed briefly, is the aspect of technology transfer to industry from government labs. You have already made some studies in this connection. How has this worked up to now? We were told by industry, as long ago as 1968 and 1969, that those transfers did not occur. We are told by others that when the R&D is initiated by the suppliers of R&D it is never used, or very seldom used by the user. Have you felt in your studies that there was adequate technology transfer from government labs to industry?

Mr. Shepherd: We have started with the position that the transfer of technology was not adequate in the light of the amounts of funds spent. We have suggested that one major element of the problem is that due to our industrial structure a large element of industry is not connected to government laboratories and, in fact, draws

its technology from its parent corporation. So there is no inclination or motivation to try to tap the very large pool of industrial technology which exists in the National Research Council. Other problems have been differing attitudes between government researchers and industrial researchers as to each other's worth. There have been indications that in several government laboratories the transfer of technology was not formally part of the mandate of those laboratories, so they tended to pay less attention to it than perhaps they should. The overwhelming impression that we have is that within the last two years the government laboratory directors have made almost heroic advances in the appreciation of the problems of industry and in attempts to put technology through to the industrial sector, and that perhaps most of the problem lies with the lack of industry awareness or motivation in terms of pulling the technology out of government.

Dr. Kates: We should add to this, Mr. Chairman, that as a follow-up to our technological transfer report No. 24, we are having meetings. We had one meeting with leading lights from the government sector just a few weeks ago. There is another one coming up. We are meeting with people from both industry and government. We are following up that report and are trying to see whether we can get the recommendations of the technology transfer report implemented. Probably in six months to one year we will be in a much better position to see whether this has any practical element to it.

The Chairman: Here again, we mentioned that back in 1972 and 1973, and we are still considering possibilities in 1976. I have here, for instance, a study which has been made for the Department of the Environment. It is entitled "Scientific and Technical Information in Relation to Aquatic Sciences and Fisheries in Canada." One of the conclusions of the study reads as follows:

While the information flow between scientists and aquatic sciences and fisheries is adequate, the flow of information from these scientists to other users is minimal.

Here we are establishing nice little seminars, and they are completely isolated from real life. They spend public money, and the result of their work is not communicated to potential users.

Mr. Shepherd: We can nevertheless note, Mr. Chairman, several significant examples of very positive action between the two sectors. The very interesting thing is the sharp change in attitude of government laboratories, who are beginning to understand the problems of industry and why they are required to help. So there has been a very positive change in attitude, and in progress, in the last two years.

The Chairman: Apparently, the progress is very slow in the area I have just mentioned.

Mr. Shepherd: It is not necessarily uniform. It depends generally upon the propensity of the laboratory and its management to act against that mandate.

The Chairman: Paragraph 26 on contracting out. Are there any questions on this?

Senator Grosart: Why hasn't it materialized? Again, Industry, Trade and Commerce seemed to be telling us that it was going well. In fact, it was one of their illustrations of the successes they are having.

Dr. Kates: We should be careful, because it depends on what standard. In fact the program at present appears to be growing very rapidly. I have just looked at the latest statistical summary and notice that in the 11-month period, from April 1, 1975, to February 29, 1976, 1,323 contracts, to an approximate value of \$102 million, were awarded under that program. That is an increase of 300 projects over the previous comparable 11-month period, of a value of \$30 million.

The problem that I think was alluded to has been described in a memorandum from MOSST itself, where they state, on the negative side—perhaps I could quote as follows:

On the negative side, however, the policy evaluation

—that is, the contracting-out policy—shows that:

—With or without the industrial support payments for R&D, the initial target of the policy to obtain a "more even balance"

—this was one of the policy objectives—

between intramural research and government-sponsored research in industry remains a distant goal.

In other words, I think they hope to accomplish that in a period of three to five years.

—Because of the nature of present science missions of government, large parts of industry have not been reached by the "make or buy" policy, nor will they be reached if government science missions remain unchanged.

—Canadian manufacturers consider research contracts to be a good mechanism to increase industrial innovative capability, and they are hopeful that major new research programs in areas such as food and energy will engage more of industry in a meaningful manner.

That is a hope at the present time. Continuing:

—Because of the exclusion of "related scientific activities" such as hydrography, meteorology, geodesy and environmental monitoring

these are large governmental programs—

—from the policy, large parts of the government's high technology activities have not become accessible for participation by Canadian industry.

And in addition, it may be noted that:

—The total resources allocated to science-based programs by government have been virtually constant during the past three years.

So there has not really been any extra money.

The modest increase that has taken place in contract research during that period represents almost the entire increase in federal science activities.

Then it states:

—From a national point of view, senior government scientists express concern about the lack of certain skills in industry. As a result, they feel strongly that a more intensive government-industry approach to science and technology is needed as a matter of national importance and urgency.

That appears to be a fair presentation of the picture. I might add to that, we do not know to what extent the increase from \$30 million to \$100 million does in fact represent contracting out or to what extent some of that increase represents programs being listed under contracting out that previously might have been under Treasury Board contracts. In any event, there are some signs of the program growing rapidly and that MOSST is constantly analyzing it and keeping the pressure on.

Senator Grosart: May I ask whether those figures show what percentage went to industry and what to universities?

Dr. Kates: This memo breaks it down in terms of the dollar value, but we could easily calculate the percentages. For example, of the \$102 million, almost \$91 million, or approximately 90 per cent, went to industry; approximately \$9 million went to universities and non-profit institutions; and \$2 million to individuals. I think the early criticism of the program was that a very high proportion went to universities, and that seems to have been overcome now.

The Chairman: Or to firms of engineers.

Dr. Kates: Yes.

Senator Hicks: They would be included in industry.

Dr. Kates: It is broken down. The table shows that primary industry received \$466,000 of the \$90 million; secondary industry got by far the largest, \$73 million, and service industries, which would include engineers, \$17 million. So, the balance is not bad.

Senator Hicks: This would tend to render inaccurate your statement in paragraph 26.

Dr. Kates: I would not want this to be overly negatively interpreted. In other words, I have the feeling that the proper posture for us is to be pleased with the fact that it is growing quickly; to be critical that it has not yet attained its previous goals, and to be hopeful that it moves towards those goals.

The Chairman: We understand that this policy, as it stands at the moment, applies only to new programs.

Dr. Kates: Yes.

The Chairman: Would you favour the extension of its application to existing programs?

Dr. Kates: Absolutely, Mr. Chairman. If the very large government activities that exist were added to industrial activities, many sectors of Canadian industry would be strengthened. It could probably be done in concert with phasing down, or transferring out of governments activities.

The Chairman: Would you favour its extension to scientific activities other than R&D?

Dr. Kates: Yes.

Senator Hicks: Am I right in my impression that in Canada industrial research and development has been dependent upon stimulation by government, either through incentive programs or by contracting-out policies, and so on, to a significantly greater extent than is the case in most other developed countries?

Mr. Shepherd: Yes, you are correct, as I understand the question. To a much greater degree than in other developed countries, our technology industries have relied upon a combination of incentives and government contracts.

Senator Hicks: So, really we are not watching a genuine improvement in the assumption of responsibility for R&D by the industries. It is still too dependent upon government incentives, and it does not mean that Canadian industries have been undertaking a responsibility in the last few years, which previously they had been neglecting, in comparison with other developed countries.

Mr. Shepherd: One of the measures of the success of contracting out will be when the innovative environment becomes so positive that industry will then begin to invest its own dollars in a rising rate of research and development.

Senator Hicks: In the constant expectation that it will pay off for them.

Mr. Shepherd: We are convinced that, if this contracting-out policy does proceed at this rate, sooner or later that will occur, and when it does we will be able to measure its success.

Senator Grosart: The figures are as high as 80 per cent in some countries in R&D and innovation funding in industry by industry.

The Chairman: Have you any other questions on this part of the brief? Unfortunately, as you know, we started late and Dr. Kates has to leave at 5.30 to catch a plane to Montreal. I do not think we will be able to go through the rest of the brief in ten minutes.

Senator Hicks: I would only comment, Mr. Chairman, on the tremendous importance, it seems to me, of the message conveyed in paragraph 31. I believe this is one of the most short-sighted policies our government is following at the present time, cutting down on the amounts of money available particularly for basic research, though for applied research to some extent as well.

The point made here is an excellent one, that when the time comes and we need the technological applications of basic and applied research, we may already have destroyed our capacity, which as stated in this paragraph, can be destroyed in a few years but takes years to rebuild. This is a very serious situation that faces all of us in Canada today.

The Chairman: Would you like to continue for another ten minutes or adjourn now?

Senator Carter: I think this would be a good time to adjourn.

The Chairman: We hope, Dr. Kates, that the next time we meet we will be able to start on time and finish our consideration of your brief.

The committee adjourned.



Government
Publications

FIRST SESSION—THIRTIETH PARLIAMENT
1974-75-76

THE SENATE OF CANADA
PROCEEDINGS OF THE
SPECIAL COMMITTEE OF THE SENATE ON
SCIENCE POLICY

The Honourable MAURICE LAMONTAGNE, P.C., *Chairman*

Issue No. 10

WEDNESDAY, MAY 5, 1976

Tenth Proceedings on:

The Study of Canadian Government and
other expenditures on scientific activities
and matters related thereto.

(Witnesses: See Minutes of Proceedings)

THE SPECIAL COMMITTEE OF THE
SENATE ON SCIENCE POLICY

The Honourable Maurice Lamontagne, P.C., *Chairman*

The Honourable Donald Cameron, *Deputy Chairman*

and

The Honourable Senators:

Asselin	Hastings
Bélisle	Hicks
Bell	Lang
Blois	Manning
Bonnell	Neiman
Bourget	Riel
Buckwold	Robichaud
Carter	Rowe
Giguère	Stanbury
Godfrey	Thompson
Goldenberg	van Roggen
Grosart	Yuzyk
Haig	

27 Members

(Quorum 5)

Order of Reference

Extract from the First Report of the Special Committee of the Senate on Science Policy, presented on July 10, 1975 and printed as an Appendix to the Minutes of the Proceedings of the Senate of that day, and adopted by the Senate on July 24, 1975.

"The Committee, therefore, recommends that it be authorized to consider and report on Canadian government and other expenditures on scientific activities and matters related thereto;

That the Committee have power to engage the services of such counsel and clerical personnel as may be necessary for the purpose of the inquiry;

That the Committee have power to send for persons, papers and records, to sit during adjournments of the Senate and to report from time to time, and

That the Committee be authorized to print such papers and evidence from day to day as may be ordered by the Committee."

Robert Fortier,
Clerk of the Senate.

Minutes of Proceedings

Wednesday, May 5, 1976.

(19)

Pursuant to adjournment and notice the Special Committee of the Senate on Science Policy met this day at 3:45 p.m., the Chairman, the Honourable Senator Lamontagne, presiding.

Present: The Honourable Senators Bonnell, Bourget, Carter, Godfrey, Grosart, Hicks, Lamontagne, Lang, Thompson and Yuzyk. (10)

In attendance: Mr. Jacques W. Ostiguy, Chief of Administration.

The Committee resumed consideration of its Order of Reference dated July 24, 1975 relating to the study of Canadian Government and other expenditures on scientific activities and matters related thereto.

The following witnesses from the Science Council of Canada were heard:

Dr. Joseph Kates,
Chairman;

Dr. Claude Fortier,
Vice-Chairman;

Mr. John J. Shepherd,
Executive Director.

Mr. Fortier made an opening statement. The witnesses then answered questions put to them by members of the Committee.

During the question period, Dr. Kates tabled a copy of his speech entitled ENERGY CONSERVATION—BLUE-PRINT FOR LEADERSHIP made to the First National Conference on Industrial Energy Conservation on May 5, 1976. This document was retained by the Clerk as part of the Committee's permanent records and a copy circulated to all Members of the Committee.

At 5:30 p.m. the Committee adjourned until 3:30 p.m., Wednesday, May 12, 1976.

ATTEST:

Patrick J. Savoie,
Clerk of the Committee.

The Special Committee of the Senate on Science Policy

Evidence

Ottawa, Wednesday, May 5, 1976

The Special Committee of the Senate on Science Policy met this day at 3.45 p.m. to consider Canadian government and other expenditures on scientific activities and matters relating thereto.

Senator Maurice Lamontagne (*Chairman*) in the Chair.

The Chairman: Honourable senators, as you can see, we are still meeting with representatives of the Science Council of Canada, namely, the Chairman, Dr. Kates; the Vice-Chairman, Dr. Fortier; and the Executive Director, Mr. Shepherd.

I understand that in the last two weeks, since we had our last meeting, there have been certain developments within the Science Council which would be of interest to us, and which, later on, might help to cut down our questions.

Dr. Fortier has been asked by his colleagues to prepare a short statement about this, which could last about eight or ten minutes. I think we should hear him, so that we may have information about the latest developments as far as the council is concerned.

Dr. Claude Fortier, Vice-Chairman, Science Council of Canada: Thank you, Mr. Chairman. I appreciate your kindness in allowing us to make this very short presentation which, as you have stated, results from recent developments at the council. A major operation was initiated, two weeks ago, which represents in many ways an extension of some of the attributes of the council and of its intentions, in a concrete way. In the brief, they had been presented in a more general fashion.

This present statement will chiefly deal with paragraphs 38 to 47, roughly, of our brief, and thus may pre-empt some of the issues liable to arise from a detailed analysis from this part of the original brief. Our hope, therefore, is to save you a good deal of time by proceeding in this fashion.

Let us start with some background information. Both our chairman, Dr. Kates, and myself, expressed in our opening statements the very serious concern of the Science Council with regard to the present state of support for science and technology in this country, and with regard to the predictable consequences of the decision of the present government to freeze support for research. What we stated at that time was that this concern was widely shared by the whole scientific and technological community of this country, especially in the university and industrial sectors. This may be illustrated by the brief presented to the Prime Minister at the beginning of March by the Academy of Science of the Royal Society of Canada and by the recent AUCC seminar on Canadian universities, which was an extremely interesting seminar,

because it brought together representatives of both levels of government, provincial and federal, and of the universities, at which they expressed their serious concern regarding the present government's attitude towards the support of extramural research.

I may list as further examples of the concern of other sectors, including the industrial sector, the two recent seminars sponsored by the Science Council, on technology transfer, the last of which brought together representatives chiefly from the manufacturing industries and from government, and at which a great deal of concern was expressed. The latest example is the symposium arranged by SCITEC last week on "Shaping Our Future Now," which, incidentally, was attended by your chairman, Senator Lamontagne, by the Honourable Mr. Drury, and by the three science-oriented M.P.s representing each of the government, the Conservatives and the NDP. It was attended also, as a disinterested participant, obviously, by the chairman of the council.

Among other examples I may quote—because I would like them to be listed on the proceedings of today's hearing—Dr. Clarke's article in the February issue of the *Science Forum*, entitled "Why is the Federal Government Starving Universities of Research Funds?" I also can mention Lydia Ditto's series in the *Globe and Mail* last month.

I would like to mention as another example Robert Grasley's remarkable presentation at the SCITEC meeting, "The Financial Climate for Technical Innovation in Canada." I close with the example of one of the best articles on the subject that I know of, which appeared last week in the April issue of *Science Forum*, from the pen of Professor Siminovitch, entitled, "The Recent Federal Research Freeze: What it means for Canadians." I assume that most of us have already read this article. These are only selected examples of the overall concerned reaction of the scientific and technological community.

What is the government's response to this situation? It is surprising, to say the least, and a matter of great concern to the council and to the scientific and technological community, and can be summarized in terms of a statement of Mr. Drury's, made during the debate in the House of Commons on science and technology of June 9 of 1975. The concluding part of Mr. Drury's statement is as follows:

There is no decline in Canada's scientific and technological effort. The emphasis is shifting, I hope, toward growth in the application of science rather than the acquisition of knowledge, but in total I feel that our science and technology are healthy and ready to aid us in meeting the future. If we have a problem in relation to science it is in deciding where to put our money.

I doubt that this remarkably optimistic assessment of the situation is shared by many people in this country, and least of all by members of the scientific and technological community and the Science Council.

Further examples of reaction to the minister's stand on the issue, which apparently result from that optimistic assessment, are reports which appeared in the Canadian press last week, on Friday and Saturday, as a result of the SCITEC meeting, which carry the headlines, "Drury Won't Give More Aid to University Researchers," in the Montreal *Star* of April 29, and, "Drury Adamant Grants Won't Change, Scientists are Told," and so forth.

Senator Hicks: How recent are those papers?

Dr. Fortier: April 29 and April 30.

Senator Hicks: Just last week.

Dr. Fortier: Yes. After the symposium. They arose out of the minister's own presentation at the meeting and from his following press conference.

I happened to find in this morning's *Gazette* possibly the most concise, sharp and clear answer to these statements of the minister for Science and Technology over the signature of Dr. Hitschfeld, who, as you know, is Dean of Graduate Studies and Vice-Principal at McGill. In view of the fact that this statement happens to summarize in a nutshell the reaction of the Canadian scientific community, I will take the liberty to give you a few excerpts because Dean Hitschfeld is very sharp, as you know, and got to the point.

"University researchers will not be given special consideration for government funding," Bud Drury, federal minister of public works, said yesterday. "The research community is suffering like everybody else from the policy of restraint," Drury said. "But it must realize the need for restraint and recognize that Canadians have been living beyond their means."

Mr. Drury's statement received a highly critical response from his audience not only because it was unwelcome but because it ignored the facts.

Mr. Drury, who incidentally is also minister of state for science and technology, well knows that between 1969 and 1975 the purchasing power of funds distributed to universities through the three federal research councils declined almost 30 per cent, while the real value of Ottawa's budget for its own "inhouse" scientific research rose 16 per cent within an increase of 39 per cent in the overall federal budget. For the current fiscal year the federal budget rises at least another 16 per cent while research funds are frozen. So much for "suffering like everybody else."

The combined budgets of the National Research Council, the Medical Research Council and the Canada Council amount to some \$130 million annually. With this modest sum (in comparison to total university budgets, or to "in-house" science in government, each of which is 10 times greater or more) council funds have been distributed in such a way as to stimulate healthy scholarly competition and excellence among universities.

It has provided a most effective unifying force among the universities and permitted a dispassionate and objective evaluation of research in Canada.

University researchers are not asking to be given "special consideration"—that's what they are now getting in a negative sense. They are quite prepared to "suffer like everybody else" where that means that all inflationary pressures are to be modified in a rational and even-handed way.

The message which must eventually be understood by Mr. Drury and his colleagues is that, compared with other developed countries, university research has always been modestly financed in Canada and that current restraints are not only unreasonable but have already *badly* damaged the very heart of the system.

I have added the word "badly" myself.

All this has been spelled out in briefs from biological, engineering, agricultural, medical and other groups who will continue to claim from the government and the public a wiser appreciation of the immense value of what is an essential investment in Canada's future.

I apologize for that long quotation. I think I gave it in full because it essentially represents my views on this particular issue.

What is the Science Council doing about it? Well, we are not standing passive. We had been preparing a line of attack for the last few months, but we could not state it before your distinguished committee before it was approved by Council, which was done at our last meeting in Regina at the end of April. This major step which gives a clear-cut illustration of our strategy in the setting up, by Council decision, of a standing steering group on research in Canada in terms of strength, structures and policies of research.

Now, I have to be clear about the purpose and tentative terms of reference of this committee which are still being refined. Essentially it has two terms of reference, the first is identification of important issues pertaining to research, and the initiation and supervision of related studies in one form or another. The second is to act or to assume a look-out role and a constant reactive ability to emerging problems and issues such as the one I pointed out.

In terms of the already identified issues, that is in terms of the first part of the terms of reference, the first one is to develop criteria and norms to assess the health of science and provide decision makers with a sounder basis to allocate appropriate budgets for science and technology. This goes back to our previous questions on R&D and so forth.

Senator Grosart: Excuse me, but has that not always been in the terms of reference for the Science Council itself?

Dr. Fortier: It has been, but I mean the type of action we are taking is quite different because we have now a group which is centred on this.

Senator Hicks: Perhaps you should explain the composition of this group or this committee. Is it to be a committee of the Science Council, or is it to be a committee sponsored by the Science Council but which goes beyond the membership of the council?

Dr. Fortier: Essentially it is a committee made up of very few members of the council, in fact two members of the council, and chiefly outsiders. But if you ask me about

the membership, senator, I think you can only understand the type of membership if I more clearly define the terms of reference, because it is essential to understand what type of members we have on it.

Senator Hicks: Has the committee been formed yet?

Dr. Fortier: Yes. The chief issue it deals with is the health of science indicators through a choice of indicators, both qualitative and quantitative, which link scientific and technological efforts to policy objectives, and when I refer to policy objectives, one of the major policy objectives we have in mind is defined as the "major program approach", and I am not going to come back to that. It has been stressed most eloquently by our chairman and executive director. This is to provide the base for identifiable targets for decision making—this also, incidentally, should be a continuous exercise.

I refer in this connection to the last report, an extremely important one, of the National Science Board, which is the policy-making branch of the National Science Foundation in the United States. This last one is an absolutely remarkable document in terms of its assessment of the various criteria for the health of science. I do not say we are going to select them as they are, but they provide a useful basis. So these indicators would help us to get the identifiable objectives and targets for which we have been looking. I say "criteria" and use the plural form, since it is most unlikely that a single indicator, such as proportion of R&D, might be the answer, and probably we will have to use a combination of indicators. I cannot resist the temptation to quote one line from this document. This I throw in as a sideline. It reads as follows:

From the viewpoint of basic scientists perhaps the most gratifying finding is that basic research contributes increasingly to technological innovation as reflected by the growing number of citations to research in patents associated with major advances in technology. The special study also found that most of the research cited in patents is basic research performed in universities.

I believe it is roughly 75 per cent. This is for the period of the study, which extends from 1950 to 1973. I mention it in terms of the continuing debate on the so-called "continuum" from basic research to innovation since it provides an interesting contribution to that debate. I just list the topics.

Another very important topic for our newly formed group is the structures for the funding of R&D in Canada in terms of a re-assessment of the roles of the granting councils, of the possible formal extension of the "make or buy" policy to university research, the role of the provincial governments in the funding of research in the light and context of the forthcoming federal-provincial negotiations on fiscal transfer as related to post-secondary education.

The third one deals with scientific manpower, which is a very serious problem in terms of the growing disparity between supply and demand at present and the existing university policies. This is not only a disparity in terms of numbers, but in suitability of the output from the universities to the market. Another problem is the very acute problem of the aging of university staff. The third one should interest you; it is an attempt to close the gap

between universities and industry in devising ways and means of cooperation and interaction between these two sectors.

With respect to the lookout role and reactive ability, this steering group should be able to respond within days or weeks to emerging situations. This leads, then, to the matter of membership. This group should be small, flexible, high powered and, obviously, selected according to the specified terms of reference. Some members have already been invited. This initial group will not include more than six members at present, but will be supplemented by a wide network of experts and consultants.

The tentative strategy has to deal with our constituencies. This will be in terms of levels of government, federal, provincial and urban, because in order to get any action taken on the recommendations of the group we need some sort of dialogue. Secondly, in terms of the scientific and technological community. There we are placed in a very good position in terms of engaging in a dialogue with already existing structures such as SCITEC and the Science Forum. Ideally I would wish these two structures eventually to combine into a sort of association which would fill the glaring gap or missing interface which presently exists between the scientific and technological communities and the lay public, on the one hand, and the politicians, on the other hand. We have two possible components, SCITEC and the Science Forum. In order for SCITEC to play that role—and I refer to it because of the great interest of your committee in that organization—I do believe that it needs grass-root membership and a channel of communication. So it is hoped that grass-root membership can be developed by SCITEC, but there is a necessary condition, and I again refer to a widespread diffusion channel. Should it prove possible, for instance, that the Science Forum become a channel of communication for SCITEC while preserving its editorial control, then we would have the condition (using as an analogy the principle underlying the atom bomb) for the two charges whose junction is needed to achieve the critical mass, v.g. the type of organization needed to close the gap. In my opinion, this is one of the glaring deficiencies of the existing structures of our scientific and technological community.

Regarding another essential organization, the Royal Society of Canada—about which I could also speak at length, since I had at one time a vested interest in the matter—in view of its restructuring as a federation of three national academies and of its increased support from the government, has all the makings for serving the role which we expect from national academies in providing a pool of expertise which no advanced country can afford to do without. The AUCC is another organization of special importance in view of the forthcoming federal-provincial negotiations on fiscal transfer regarding the financing of post-secondary education and the related problem of research funding. I also consider that the Canadian Manufacturers' Association, the Canadian Council of Engineers, the CRME, and so forth, should be an important part of the dialogue.

Needless to say, we also rely heavily on the three granting councils to act as extremely useful consultants in this exercise and to use their existing structures, their grant committees in particular, to provide an ideal mechanism for assessing the health of science in terms of its component disciplines.

In my opinion, the prototype of a successful exercise of that nature is the 1968 Report No. 2 of the Medical Research Council on "Medical Research in Canada", which was based on a large-scale survey by 15 teams of specialists who gathered information to provide the type of qualitative and quantitative assessment which served thereafter as a basis for the further policies of the MRC.

So these are the types of mechanisms I have in mind in terms of assessing the health of science. Public relations is another very important part of our program. However, I have already exceeded the time allotted me by your chairman, for which I apologize. As a further comment, I would say that this exercise, which becomes one of the major projects of the Science Council, illustrates many of the aspects with which we have dealt in our brief.

The Chairman: If the council feels that they would like to present us with this new policy, or this new framework, as a kind of addendum to the brief which has already been presented to us, I am sure it will be welcomed by the members of the committee.

What you have said here may raise a few issues which may well come back as we go through these different paragraphs, and I would suggest that if honourable senators have no specific questions at that time on the statement made by Dr. Fortier, we should resume our procedure of going from one paragraph to the next.

Senator Hicks: If it is not inappropriate, I would like to ask Dr. Fortier to identify this committee, in which I am very interested. Is there any reason why we should not know the membership of this committee?

Dr. Fortier: The honourable senator places me in a difficult situation.

Senator Hicks: I did not mean to do that.

Dr. Fortier: We have selected the members. I am chairing the group.

The other member from Council is, Dr. Vogel-Sprott, a distinguished psychologist from Waterloo University, who, in view of her particular interest in the matter, will probably be involved chiefly in our scientific manpower study.

The issue becomes delicate when it comes to the potential members we have in mind from outside Council, some of whom have already been approached. One has given an unreserved and most enthusiastic commitment. He is a professor at the University of Toronto and a most distinguished scientist. Another outstanding scientist from the same university, Professor John Polanyi, has given tentative and conditional assent, in view of his further assessment of the compatibility between his intense scientific activities and the time and effort involved in the group's program.

The Chairman: I understand that you have your "cabinet", but they have not yet been sworn in!

Dr. Fortier: Well, they do not need to be sworn in.

The Chairman: But you are not in a position to make the membership public at the moment?

Dr. Fortier: Perhaps my answer might be off the record, with the chairman's consent.

Senator Hicks: I do not think we need to press that further. But in due course the committee will make its presence known, will it?

Dr. Fortier: The first full meeting of the committee will occur in the near future. The date will depend upon the availability of all its members.

Senator Hicks: In due course the committee will have to make itself known, including its membership, if it is to assert any influence where that influence will be useful.

Dr. Fortier: This is the first occasion on which the committee is making itself known.

Senator Godfrey: Are they all scientists?

Dr. Fortier: No.

Senator Grosart: Is there a representative of industry on it?

Dr. Fortier: There will be one. We also consider inviting a representative from the financial and economic sector.

Senator Hicks: Coming from where? Not from inside the government?

Dr. Fortier: No, from the private sector.

Senator Bourget: Mr. Chairman, some names have been mentioned by Dr. Fortier. I was wondering whether we should not ask the reporter to drop those names from the record.

The Chairman: The committee will be known before the proceedings of our own committee are printed.

Dr. Fortier: There is nothing wrong, I hope, in my having mentioned the other members from Council and one of the potential members from outside Council whom we have approached.

Senator Bourget: It is up to you.

Senator Grosart: I wanted to make the comment that when I heard this very excellent exposition by Dr. Fortier of the dire necessity of an immediate change in government policy, I was looking forward with bated breath to hearing what was the solution. I had hoped that it would not be another committee, which I find it is. I was rather hoping that the Science Council was going to organize a march of scientists on the Hill.

Dr. Fortier: May I take that up, Senator Grosart? Our interest in the missing link that I referred to is, I think, the beginning of the answer. Once we have an integrated, coherent scientific and technological community, I think we will go a long way to achieving what you have in mind. In one way we beg to differ with your recommendation, Mr. Chairman.

The Chairman: In what way?

Dr. Fortier: In the concept of a single voice for science and technology. This, if I may express a personal opinion, I do not think is possible. On the basis of the experience of other nations, it has never been achieved. Scientists are by nature individualists. Moreover, the various components of the scientific and technological community are

so very diverse, ranging from the Association of Physicists to the Association of Technologists and to the Canadian Council of Engineers. We have such different interests that only on the most general type of issue, such as the health of science and technology, they will all agree; but get them down to specifics, and you have a heated debate. This is the sort of debate we want; an intelligent debate on topics of national relevance and the forum needed to make it possible. It necessitates that scientists awaken—and quite a number of them have—to their role as citizens of this country, and to an interest in matters going beyond the realm of their own disciplines or professional interests. Such an objective has often been advocated by Senator Lamontagne and the members of his committee as an essential condition for the achievement of our common purpose—that is, the optional contribution of science and technology to our national goals.

Senator Grosart: What you have said about the problem of diversity of interests and viewpoints, and the problem of consensus, is exactly what was said from your very seat five years ago when we suggested the organization of SCITEC. We were told at that time that there is no way there could be one voice. We have heard this same thing from the exporters and importers. They say they all have different interests. Everybody tells us the same story—"We are so diverse we could never speak with one voice." As we have said in this committee from the start, if the scientists do not find one voice no one is going to listen to them, and we will be in exactly the same situation 10 years from now.

Dr. Fortier: If I may take exception—and this may have been a possible misinterpretation on my part of your reports—when your committee recommended, in Volume No. 3, that the Royal Society and SCITEC be officially considered as the respective voices for "science for policy," and "policy for science," I personally interpreted this statement as implying single voices in these respects. As I have already said, I may be wrong in my interpretation.

The Chairman: I already detect two voices. Most of the recommendations we made at that time were after very close consultation with the Royal Society. You were not its president at that time, but we did consult with your predecessor and quite a large group from the Royal Society.

Dr. Fortier: I would have welcomed the support of your committee at that time, Mr. Chairman. We needed it badly. In any event, the term "voice" was used.

The Chairman: You are trying to organize another voice now. We welcome it and we hope that it will be heard.

Dr. Fortier: You have made your point, Mr. Chairman. However, I do hope that whatever voice we achieve, there will be a large degree of consensus between your committee and the Science Council.

The Chairman: I hope so. Moving on, I think we stopped at paragraph 29 on page 12. Are there any questions in relation to paragraph 29?

Senator Grosart: I wonder if I might ask a question relating to both paragraphs 29 and 30. The subject-matter

of my question runs into paragraph 30, which is under the same heading of "Technological Interdependence." The phrase "...cost of technological interdependency" is used in paragraph 29, and in paragraph 30 we have the statement:

... Canada can replace its present overdependence on foreign technology by true interdependence.

Could we have some information from our witnesses on the present dimensions of this overdependence, the optimum condition for interdependence, and the essential change that is needed? We have this phrase, "present overdependence on foreign technology".

The Chairman: We can deal with the two paragraphs at the same time.

Mr. J. J. Shepherd, Executive Director, Science Council of Canada: If I may speak to that, Mr. Chairman, well over 75 per cent of the technology that is deployed in this country is imported from one territorial source, which is the United States. In many cases, it is deployed under the umbrella of ownership. In many cases, therefore, there tend to be restraints on the amplification of that technology as we try to move it into the marketplace, or as we try in this country to further develop that particular technology.

One notes with concern a situation where perhaps one's main frame computers, one's major defence systems, and a great many other critical technologies all come from one single national area. The feeling is that the policy that one has to try to achieve, without in any sense being negative, is to develop a balance of technical capability, some of which—and much more of which than heretofore—is developed within this country, and the balance of which is spread much more evenly amongst other nations. Not only does that open up the option to acquire more technologies from other countries, but to dispense more technologies to other countries and to trade with those other countries.

The idea of technical interdependence is really the underpinning for the third option strategy, and the benefit that would derive from it is not only the screening and acquisition of a wider pool of technologies than is now open to us, but it gives us more options from which to choose in the future and poses, perhaps, fewer constraints on the technologies that are now in this country.

Senator Grosart: On an international comparative basis, what is the significance of our 75 per cent dependence on the United States?

Mr. Shepherd: At the crudest possible guess, if one looks at the way in which Japan acquired its technologies, which was not under the umbrella of ownership but through licence agreements which it could then exploit in terms of its own developmental additives, I would suggest that probably in relation to Japan, Germany or France one could look at the reverse of that situation.

Senator Carter: You say we have a 75 per cent overdependence on the United States. Is that not increasing?

Mr. Shepherd: Let me first say that the percentage is an extremely crude one and is based on a set of personal judgments and judgments derived from other people. It is 75 per cent of the total technologies that we have in this

country, whether from NRC, from overseas, or from Canadian industry, and it represents a dangerous level of dependence. The figure I am using is extremely crude, and I am using it to show that the reverse is true in most other developed countries and that we have to seek to attain a balance.

Senator Carter: My point was that we are talking about going from overdependence to interdependence, but we are still going in the direction of overdependence. We have not yet reversed the process.

Mr. Shepherd: That is substantially correct, senator. However, the rate has slowed down because of the increase in our connections with such countries as Germany, Japan and France, as we have begun to trade in technologies with those countries.

Senator Grosart: Does that figure of 75 per cent include both the imported technologies through foreign ownership, as well as directly imported technologies under lease?

Mr. Shepherd: Yes.

Senator Grosart: What is the proportion between the imported technologies that are still under foreign ownership and the percentage that is leased and imported in other ways by Canadian firms?

Mr. Shepherd: I will not cite a number, because I am using very rough judgments, and I would not like to be pinned to a specific number. The general judgment is that by far the major amount of technology that is imported is imported through the parent-to-branch plant system in the form of engineering, drawings, designs, and so forth. That is by far the overwhelming pattern for the importation of technology.

Senator Grosart: Would you make a guess, in relation to total Canadian technology used, as to the percentage left which is domestically operated?

Mr. Shepherd: It would be slight, senator. I do not wish to be pushed into a number, because there are certain sectors, such as in communications technology, where there is a rapidly growing Canadian capability. These are the exceptions rather than the rule. By far the bulk comes in the form of ownership.

Senator Grosart: Would you say that the maximum might be in the range of 5 to 10 per cent?

Mr. Shepherd: I would not like to be pushed into a number, but it is in that order, I would think.

Senator Hicks: Is it fair, Mr. Chairman, for me to ask Mr. Shepherd to elaborate on what technology is included in the 75 per cent figure?

You do not include basic research techniques, and things like that, do you?

Senator Grosart: He is talking about technology.

Mr. Shepherd: I include all forms of technology, ranging from research to production design. In the main, it is generally imported in the form of designs and production designs achieved elsewhere and transmitted through into Canada where the branch plant will amend that design to suit it to local conditions. Although there may be very

little pure research imported as research, it does come in its produced form of design and design information.

Senator Grosart: Are you really talking about science available to be sold?

Mr. Shepherd: Yes. I am really saying, senator, that we do the science and other people import and use the technology.

The Chairman: Ideas in exile. Are there any other questions on those two paragraphs?

We have already discussed at length paragraph 31, which is on research capability. Are there any further questions on that paragraph?

Senator Carter: You say in your brief that current budgetary constraints are dangerously eroding our capacity for basic and applied research and Canada could be left without a research base at the very time when economic recovery will demand an increase in R&D activity. Is the committee you told us about going to get into action soon enough to do something about it?

Dr. Fortier: We do hope so. I can give you a list of references, although I do not want to take up more of your time. Two of the most useful pieces of information on the subject are Siminovitch's article in the April issue of *Science Forum*, and Robert Grasley's paper presented at last week's forum sponsored by SCITEC. I think it might take up too much of your time to summarize these two papers vis-à-vis the present situation. What we intend to do about it is an attempt to mobilize the scientific and technological community to change the situation. This implies our helping to develop through the scientific community enough public pressure to change the type of decision-making we have been facing. We fully understand that politicians take other consideration into account. We assume they are all devoted to the national interest, but there are also personal pressures, depending on the type of issues and topics which will gain them votes. If there is a solid enough block of the public that can exert pressure, it should have some effect. Furthermore, the scientific and technological community of this country, in itself, is not a minor group or constituency which can be ignored; it represents roughly 115,000 people. It would greatly help if we could get their collective support. Hence our great interest in strongly advocating the type of organization based on grass-root membership and therefore actually representing this community.

There is one issue in particular for which a single voice could possibly be effective, and on which a consensus has already been achieved, and that is realization of the fact that our whole scientific and technological structure is rapidly crumbling, and, according to my own assessment, if the present government's policy with regard to the support of research is maintained for another three years it will be the beginning of the end.

Senator Grosart: We have had three years.

Dr. Fortier: Three further years.

Senator Grosart: Three more years?

Dr. Fortier: Three more years and we will have to start from scratch. This is not a reversible process. As you know, students engaging in a career in research at present need a highly adventurous spirit since there is no obvious opening for them in the current context. That is, I think, hitting us fast.

Senator Carter: Several years ago there was a revulsion amongst students against science; they just did not want anything to do with it. Has that changed?

Dr. Fortier: Sure it has. The most interesting part of the study I referred to is a survey by an independent firm for the National Science Board. This was a very extensive survey of the public attitude towards science and technology. It is entitled, "Was there an anti-science backlash?" According to the survey, there was not.

Senator Carter: There was not?

Dr. Fortier: No, not by the general public. Their belief in the possibility of the contribution of science and technology to the welfare of the country has, if anything, increased markedly over the last two years. For instance, 56 per cent described their general reaction to science and technology as one of satisfaction and hope, compared with only 49 per cent two years earlier. Science and technology was believed to have done more good than harm by 57 per cent in 1974, compared with 54 per cent in 1972. There is every evidence that this idea that there is a backlash is partly mythological. If there was such a thing, or any indication of it, it is receding, according to these figures.

Senator Carter: That is encouraging.

Senator Grosart: My question arises out of paragraph 31. Are you saying, Dr. Fortier, that unless there is a drastic change in the funding of development and research and technological innovation Canada's capacity for basic and applied research will be destroyed?

Dr. Fortier: Yes. I have nothing to add to this statement.

Senator Grosart: Three years on top of the four years of decline?

Dr. Fortier: This is a rough estimate; it may be plus or minus two or three months.

Senator Grosart: But you would say that Canada's research and development capacity will be destroyed?

Dr. Fortier: Yes.

Senator Grosart: Why aren't you marching on the Hill?

Dr. J. Kates, Chairman, Science Council of Canada: Perhaps I could add some further explanation in response to Senator Carter's question directed to the relevance of what we do. I think you will find that what we do from now will be a multi-stage program. I think Dr. Fortier has explained how that applies to the field of academic research, and I can explain to you how we are applying it also to the field of industrial research.

On academic research, Dr. Fortier's opening statement basically marks our immediate reaction; in other words, we are putting our judgment together and trying to determine the immediate needs. As I explained at the last

session, the immediate need is basically to preserve the scientific community, and to do it by getting back to the 1969 funding levels. Dr. Fortier has just explained that we have an interim program, which looks particularly at the manpower situation, and we hope to be able to produce a report on that within a few months. We have a longer term program which deals with indicators for the health of science.

I can give a similar example in the industrial field. In order to react to Mr. Chretien's statement of discontinuance of industrial incentives, I immediately published the statement of which you are aware. Our industrial committee has a short range program which is looking at the incentives and what should be the guiding principles of the incentives, which at the present time are being reviewed by the Department of Trade, Industry and Commerce. We hope to be able to comment in a relatively short time, in a month or so, on what ought to be the guiding principles underlying that. Our long-range program will deal with industrial strategy and become more specific about the industrial strategies that ought to be preferred. I think you will find that in all our programs we will try to be relevant. We will do that not by disposing of our long range view but by being relevant to the immediate situation, to the short range situation and the long range situation.

The second point I want to add here—because it could be misunderstood, especially when you were asking about marching and so on—is that the Science Council is, of course, not a lobby. We do not consider ourselves a lobby. Our job is to assess the situation, but in assessing it we do have to communicate with the various interested groups and try to develop a consensus. I think it is up to the associations to do the lobbying and marching. I do not think that is our job.

The Chairman: You do not want to be there with that kind of weather.

Dr. Kates: In a different capacity, of course. We all belong to associations, and we might be marching with them, but not in the capacity of the Science Council.

Senator Grosart: Your terms of reference require you to give objective advice. It is a very wide term. You can give objective advice in other ways than merely publishing reports. That is all I am suggesting, because when I look at Report No. 4, which goes back some five years, I wonder if anyone paid any attention to it. That was your priority report. Practically nothing has been done about it. So, why keep on publishing reports? You are on item No. 20 now, I think.

Mr. Shepherd: If I may argue with you, senator, it is our responsibility to keep publishing reports and to develop impact for them. Nothing is more current than Report No. 4, in terms of getting major programs going, which we continue to advocate.

Senator Grosart: You are going to continue to advocate for years.

Mr. Shepherd: We do have, senator, one or two major programs announced and the only problem now in the oceans program, for instance, is that the muscle behind the major program is not being provided. So, some progress has been made, albeit inadequate.

Dr. Fortier: With the permission of the chairman, Senator Grosart, I would like to add a comment. In terms of publishing reports and making detailed and scholarly studies, of course it is part of our exercise, as stated by the chairman and Mr. Shepherd.

There is an additional dimension on which we are presently placing much emphasis, and it is the reactive ability I refer to, in terms of our capability.

More, in terms of Dr. Kates' remarks, I would like to make it quite clear that the steering committee on research is not restricted to university research, although quite obviously it is an important part. You cannot split the sectors in terms of policymaking.

I made several references to our interest with regard to industrial research, and what I would like to emphasize is the complementary and overlapping role of two closely related groups in terms of this new orientation—the committee for industrial strategy and the steering group for research. In their objectives, they are somewhat overlapping and quite obviously we will join forces on many of our programs and issues.

There is no such thing in the Science Council as a polarization between academic basic research, at one end of the spectrum and industrial research at the other. There are obviously people who have greater expertise in one of these sectors but we are trying to act as citizens and combine our different expertise in order to reach common objectives. I think it makes it clearer, in terms of relationship.

Senator Grosart: I hope I will not be misunderstood. We are exactly in the same boat. We are still in the business of issuing reports, and I would hope, if the Science Council can inspire, if not organize the march, they will insist that this committee will be out in the front lines under the batons of the gendarmes.

The Chairman: One thing I cannot understand though is that we have asked a few questions on the supply and demand of scientific and technological manpower in Canada of the officials of MOSST when they were before us. They told us they did not know very much about the situation. We asked questions about the brain drain and they did not know very much about it. I asked a question about the brain gain and, again, there was no definite answer. Now, you come here today and say that if we do not do something, three years from now it will be gone.

Dr. Fortier: Mr. Chairman, we did not claim to have all of the answers, but we are really going after them.

The Chairman: We have been discussing science policy for years now and we found the other day that we are still without any proper figures and data on qualified engineer manpower in Canada.

Dr. Fortier: As I mentioned, this is one of the major topics of interest for our committee. In fact, there is a subdivision in that mandate, dealing specifically with scientific manpower, in the terms I have defined.

We already have a bank of information and, at least, some previous efforts have been made. I refer to the tri-council report of three or four years ago and to the highly qualified manpower report which provided some information. It did not deliver much of an impact. I should also

mention the report on graduate studies in Ontario, which deals with that issue. There is a need for updating this information, obviously. What has been studied so far is the supply situation. Very little attention has been paid to the relationship between supply and demand. This is one of our major objectives. As a start we have already gathered most of the available background information. Three members of our staff have been actively working on updating this information. I will not detail our planning at this stage, but it is already far beyond the initial stage.

The Chairman: I am glad, that after five or six years we are moving.

Senator Grosart: We are moving the wrong way.

The Chairman: That is not a criticism, it is just an observation.

Dr. Fortier: Mr. Chairman, you have gone a long way in favouring this approach by drawing the attention of the public and the Science Council to this problem.

The Chairman: If we are all dead three years from now, it is perhaps a little too late to start studies today.

Dr. Fortier: Mr. Chairman, this is what I meant by our collective hope.

The Chairman: You should have created your steering committee six years ago.

Dr. Kates: We have published, of course, very specific studies. You will find a lot of comments on manpower. We also had a study, No. 20, entitled "Prospects for Scientists and Engineers in Canada" by Frank Kelly. Unfortunately, Mr. Chairman, attention is not being paid to that study. I would also draw your attention to study No. 28, "Education, Jobs, Career Patterns." So, this is a subject that we have looked at from time to time; published statistics, made recommendations. What is happening now, at least, in the foreseeable future, is that a steering committee is being set up to deal with it rather than develop a study and not continue with it.

The Chairman: As I remember, during the first day of our inquiry the National Research Council had produced a study, and at that time they were forecasting all kinds of situations where the supply of qualified scientists and engineers would be too great, in comparison to our needs.

Senator Bourget: We are surprised, Mr. Chairman, that MOSST couldn't give us some figures about it, when the information was coming from the Science Council and previously by the National Research Council.

Dr. Fortier: We have lots of figures, senator, and moreover—I may commit an indiscretion by mentioning this...

The Chairman: This is the proper day for that.

Dr. Fortier: ... that as part of the exercise we are contemplating may involve using as our chief resource man the top-most authority in the United States on this problem of manpower and the relationship of supply and demand. I might go too far if I name the individual.

The Chairman: Dr. Holloman.

Dr. Fortier: That is correct, sir.

The Chairman: It is no secret.

Dr. Fortier: The indiscretion is not mine, then, Mr. Chairman.

Senator Grosart: I am afraid our concern would be that what the chairman of the Science Council has described as a standing committee will take as its motto Milton's immortal line: "They also serve who only stand and wait."

Dr. Kates: I think you will find us reasonably action-oriented, senator.

Senator Grosart: That is why I suggested "March!"

Dr. Kates: Somebody has to produce the ammunition and somebody has to use it.

The Chairman: Shall we proceed?

Senator Carter: I move that we take sections 32 and 33 together, Mr. Chairman.

The Chairman: I was going to move that we postpone those, because most of the information related to those two paragraphs will be given to us by the Science Council in their answer to our questionnaire on future studies. So we will come back to those later on, I presume.

Are there any questions on the conserver society? How do you want to develop this new activity? I understand that you are giving a high priority to the conserver society as an area of concern for the Science Council. This is a new one.

Dr. Kates: Yes. To give you a specific idea, I gave a speech today on applying basically the philosophy we have developed here in a very practical way to the energy problems in Canada. With respect to the conserver society group, this was an informal speech providing very practical concepts which we hope the government will adopt. In a relatively short time the committee and the working group on the conserver society hope to develop more fundamental underpinnings—in other words, a short report on what we ought to do about energy conservation. In order to be specific, they will probably move on from there to other fields of conservation. So you can expect a series of reports and recommendations to emanate at intervals from this exercise.

Dr. Fortier: Mr. Chairman, would I be rash in suggesting without first consulting with my chief, Dr. Kates, that, to my mind, his speech is a major statement on our concepts of the conserver society; it is a most clear-cut exercise in reconciling what has so far been considered as a negative stance when one speaks of the conserver society with the exploitation of the opportunities which it offers; and I think nowhere can these concepts be better illustrated than in the chairman's speech. May I suggest that his speech be tabled and perhaps published along with the proceedings of this meeting?

The Chairman: I think it would not be appropriate to print it, but we will certainly see to it that copies are distributed to all members of the committee. It would be rather a duplication if it were to be printed along with our proceedings. Moreover, you are better organized with the press than we are.

Dr. Kates: I should point out, Mr. Chairman, that this is just an informal conceptual thing and that the real report is still to come.

The Chairman: Yes. We understand. The next item is No. 35.

Senator Carter: We are doing quite a bit of work with third world countries, helping them to build up their self-help programs. Especially due to the IDRC, you seem to be doing a lot of scientific work. Do you think that under the circumstances in which we find ourselves we should be doing more? Is that what you are implying here?

Dr. Kates: Do you mean within the Science Council?

Senator Carter: I mean the Government of Canada.

Dr. Kates: You mean whether Canada ought to be doing more?

Senator Carter: Yes. Is the Science Council carrying on the same kind of work as the IDRC?

Mr. Shepherd: We are in the middle of a food program study at the moment, and the conviction is developing, which must be clearly obvious, that we cannot solve the food problems of the world. We have to try, as another leg in terms of output additional to agricultural output, to dispense technology to those nations so that they can develop their own agricultural capabilities, for instance. Therefore, one of the efforts in our food study will probably be to recommend the implementation and acceleration of those measures. We ourselves, of course, have no mandate to actually engage in the technologies themselves or in the funding of them as the IDRC has.

Senator Carter: You leave the funding to IDRC.

Mr. Shepherd: Yes.

Dr. Kates: In answer to your question, there is a policy question involved here and I have had communications with the IDRC to educate myself. The present policy in Canada appears basically to be to react to requests from other countries. It is a good question whether, in a matter of scientific aid and so on, this ought to be the policy of the country. It does not seem to me that there is a body in Canada which feels it is its mission to discuss the various policy alternatives, should we decide what technologies and what science we should pass on to other countries. Whether or not it is correct to let them decide it and simply react to that kind of question, the IDRC, I believe, do not feel that it is their mandate to look at this type of problem.

Senator Carter: What about CIDA? Does CIDA get involved in scientific problems as well as scientific programs?

Dr. Kates: Yes, basically they are the foreign aid arm, but again I do not know because I have not had communication with CIDA as I have had recently with IDRC. It does not seem to me that there is an independent body like ours looking at the question of the scientific content in the foreign aid and foreign trade dealings. In other words, I have a feeling that this area may be falling between several stones. You know, we may discuss in the

Council whether we should stick our nose into it. It is strictly on the policy side; not on the question of funding or influencing specific research projects, but with what we gather about the future of science and technology, with respect to both the opportunities and the very severe problems: ought it to be a laissez faire attitude or not.

Senator Grosart: CIDA has shown considerable interest in the transfer of science and technology from Canada to other countries.

Dr. Kates: Yes, but the question I am posing is not that. The question I am posing is that the country at the moment has a policy—at least so we say, because, you know, sometimes I am not certain whether it is really so—by which we simply react to the demands of other governments in helping towards science and our foreign aid. I am quite certain that a great deal of what other governments ask us is stimulated, in fact, from within Canada; but the question you have to ask yourself, when you look at the future, is whether this is a correct policy. It may be correct, or it may not, and all I am saying is that I do not believe there is any organism in Canada that is looking independently at that question.

Senator Grosart: The aid consortia have done this, and actually are continually studying the make-up of the international aid programs to individual countries, in the course of which they have laid particular stress on the transfer of science and technology component. It is true that we are on a response basis, but that is at the request of the developing countries. It is not our policy. That is what they have asked for.

Dr. Kates: Yes, but as I say, it is a policy question. It is a question of whether it should or should not be our policy.

Senator Bourget: Is the U.N. not looking after it? I think the U.N. has special agencies looking into the transfer of technology or science to developing countries, also.

Dr. Kates: Surely our foreign policy is decided in this country. There was a little confusion, frankly, in my own mind, until a short time ago. That is why I have been talking to the various agencies, and trying to find out whether IDRC, CIDA, and other similar bodies are looking at the situation, and I am wondering whether, with the kind of technologies we are dealing with—for instance, nuclear technology, which is the subject of a heavy debate—our attitudes and decisions constitute a real policy stance, or whether we are simply reacting to the wishes of other countries. If it is a policy stance, is it a correct stance, or ought we to be drawing limits? I have a feeling that there is no independent group—for instance, a foreign aid science council—looking at the situation. There is no science policy council, for instance, that I know of, especially in the light of the kinds of technology we are talking about, and the kinds of international relationships that are being developed, advising on the safeguard treaty. This is being done in Parliament, but it is not being done by a body like us.

Senator Grosart: But the OAS is conducting seminars on this very subject—in fact, I have attended one—of the transfer of science and technology, during which they call in the aid-giving countries and discuss this very

question with them. I am surprised to hear you say that there is no assessment being made. I know of four or five continuing assessments of the science and technology transfer component of Canadian aid. It is going on.

Dr. Kates: Being done by whom?

Senator Grosart: The OAS—the Organization of American States. It holds two seminars a year.

Dr. Kates: But I am talking about a Canadian organization.

Senator Grosart: But Canada is represented at these meetings.

Dr. Kates: What I am talking about is the fact that we are a body that is supposed to give independent advice on Canadian science policy. Now, if you look at the ramifications of our policies in the foreign aid and trade areas in relationship to science and technology, this is a very important field, and a policy stance is being taken by the government which may be a right stance, or it may be a wrong stance. I myself thought that the IDRC was reviewing policy itself, and saying, "Well, in view of the kinds of programs that go along with modern science and technology, ought we to put limits on our policies, or ought we to adopt a laissez-faire policy?" Of course, you have to talk to them to get their own views, but my impression is that they do not feel that a broad policy stance is in their mandate. We, I believe, have not considered it to be our mandate, particularly, because we have been directed more towards the internal requirements of science and technology in this country, rather than to the external ones; so it is my feeling that there is no body like the Science Council, an independent body, that is proffering advice, other than other groups which constitute themselves and then exert political pressure. There is no independent thinking by a group like ours in connection with that problem, which is, of course, a very important problem.

Senator Grosart: But CIDA, which is a Crown corporation, is doing that very thing. They are assessing the components of their aid in the specific context of the transfer of science and technology. How many such groups do you want doing it?

Dr. Kates: I feel that CIDA is specifically a line agency.

Senator Grosart: It is assessing the component in consultation with those who ask for our aid. IDRC has an entirely different function. It is not concerned with the transfer of Canadian science or technology. Its mandate is strictly to upgrade and fund research abroad.

Dr. Kates: They are the equivalent of the NRC, or the Canada Council granting function. Right?

Senator Grosart: Yes; but not in respect of the transfer of Canadian science and technology. It is none of IDRC's business.

Dr. Kates: All I want to clarify is that it appears to me to be a policy area where people may believe that there are independent advisory organizations looking at the situation, but my impression is that this is not so.

The Chairman: Shall we move to another area? What about the major programs, dealt with in paragraphs 36 and 37?

Senator Grosart: The question I would like to ask, Mr. Chairman, concerns the distinction that has been made, particularly in paragraph 37, between major programs and projects. Perhaps it is just semantics, and I think it is. What is the essential difference between the two, apart from the definition given here that the programs are envisaged as the principal instrument for the growth and development of Canadian science and technology? Surely that is not your description of a program? What is the distinction you make?

Mr. Shepherd: The distinction between the two is related to the pervasiveness of the program. If we take, for instance, a neutron generator, or the TRIUMF facility, the impact of that spending is largely, or purely, on the scientific community. If we take a major program such as the oceans program, which will affect universities, governments, scientists, industry, and, in fact, the whole economy, through a large number of jobs, through the multiplier effect, then we distinguish that as a major program. So there is in fact a very sharp distinction that is drawn on the basis of the pervasiveness of the program. We are deliberately excluding from major programs those which may be of significant expenditure, but the economic and social effect of which is very narrow.

Senator Grosart: That hardly makes a distinction between a program and a project.

Mr. Shepherd: I think it makes a very strong distinction, to the extent that if one were to list 20 or 30 major funding endeavours, one could very rapidly classify them, which is the object of the exercise.

Senator Grosart: Yes, if you decided you were going to call one set programs and one set projects; but no one reading and speaking English would go along with you unless they had your definition in front of them all the time.

Senator Godfrey: Well now, in fairness to the witness, I looked at paragraph 37, and then went back to paragraph 36. Paragraph 37 says:

Some of these barely meet our definition of major programs, as stated in paragraph 36 (underlined). Other large expenditures on science, such as project TRIUMF and the Hawaii telescope project, represent significant contributions to the development of science in Canada, but do not meet the requirements by which we wish to distinguish major programs from major projects.

Paragraph 36 says that a major program is one which has as its goal the solution of some important or national problem.

The Chairman: I suppose our research effort related to the oceans could constitute an oceans program.

Senator Grosart: Of course it could. You could take any of them and call them either a program or a project.

The Chairman: When you come to STOL you call it a program, but when you come to TRIUMF you call it a

project. I do not think the distinction is too important, but it seems to me that we should discuss the substance of these two paragraphs.

Senator Godfrey: What struck me when I read this, I must say, in view of your comment earlier, Dr. Fortier, about basic research, is that this is really advocating, in a way, downgrading basic research, because it is going to be misoriented, is it not?

Dr. Fortier: No, sir.

Senator Grosart: Never by the Science Council!

Dr. Fortier: To add further fuel to the semantic argument, a project is, as pointed out by Mr. Shepherd, more limited in scope and more limited in the type of integration and coordination it requires. It might concern a very small sector. The intense neutron generator is an obvious case, and TRIUMF is another. Whom will TRIUMF benefit? A very small scientific community, I think, though it will be to the larger benefit of mankind eventually by its contribution to a knowledge pool. I would personally classify STOL as a project, as opposed to the chairman's classification.

The Chairman: That is your classification.

Dr. Fortier: I am sorry. I misunderstood it. But the problems of the oceans, pollution, transportation in Canada, our urban problems—all these require a concerted effort of the academic community, of the industrial sector, of the various branches of government, of experts from every possible field of expertise, obviously including—because I know you are quite sensitive to the issue, Mr. Chairman—sociologists, economists, political scientists, and jurisdictional experts, because this is something we continuously come upon in many of the recommendations we make at Council, not forgetting the major problems and the peculiarities of our Canadian context in terms of inter-relationships between the federal, provincial and urban levels, since I referred to the urban program. So this is the type of approach for major programs, if you take urban problems and transportation, which obviously would have that type of scope and would require the integration and concerted effort of all these members. However, you cannot say the same thing for the intense neutron generator or STOL (projects). The line of distinction remains.

In terms of science and technological input, here again you have the matter of content. You may have to rely for some parts of these major programs on basic scientists. I illustrated the number of references quoted in patents. Sometimes in order to get an immediate relevant application or objective in terms of innovation, if you lack the basic knowledge required you have to get it.

Senator Grosart: That would apply to a project or to a program. It would be a very unhappy situation if something you called a project did not have the maximum input of science. I don't care what project it is. That is the whole criticism of many of the things that you call projects in that they fall short of this multi-scientific approach. You leave out one, the economist or the sociologist, whether it is a project or a program.

Dr. Fortier: But, Senator Grosart, the main point of our program is our continuous insistence on the major program approach and not the project approach.

Senator Grosart: I don't know whether it is a program or a project, but what I want to see is the full impact of all our science knowledge on everything.

Dr. Fortier: We want a concerted effort.

Senator Grosart: I object to your making that distinction.

Senator Hicks: If you are going to argue with him, you have to argue with the terms that have been used in the report.

Senator Grosart: That is what I am arguing.

Senator Hicks: What you are saying is that you don't like the terminology they use, but, as Senator Godfrey explains, it is perfectly clear once you take the trouble to study it.

Senator Grosart: The only point I will make is that the words you use very often control or expose your thinking. That is my objection.

Senator Godfrey: Well, on the question of semantics you can have basic research that is directed. I had an idea that basic research was something that somebody did just out of curiosity, and that it was something that was not related to anything in particular.

Dr. Fortier: As soon as it is related to a definite end, then it is strategic research.

Senator Hicks: But here again you are getting into a matter of definition. Different people use different terms to describe the same type of research.

Senator Godfrey: But the criticism of basic research, as I can remember from some years ago, is that it goes off in all directions without being oriented, and then once it becomes oriented it is called something else and has to become more useful.

Dr. Fortier: I have to react to this, Mr. Chairman, and I simply have to take the bait. I do believe, as a basic researcher, that at the extreme end of the spectrum, where, I must confess, I personally stand, there is a place for curiosity-oriented basic research, a very important place. But there is a need, an acute need, for a far larger proportion of basic research to become mission-oriented or strategic, if you prefer that term, and I prefer the term "strategic" to "mission-oriented". This has been the object of our recommendations on this subject in our Report No. 5, on federal funding of university research, and in Report No. 18, I believe, on policy objectives for basic research. What was the first recommendation in this report? That the greater proportion should be mission-oriented. What was the first recommendation in the conclusion of my opening statement? That again was underlining this simple fact, but the greater proportion does not mean that non-mission-oriented basic research should disappear. I think it would be a catastrophe. And I would also lose one of my major justifications as a scientist and citizen.

Senator Hicks: As a university person, I have to insist upon the continuance of curiosity-oriented basic research, and if we demand that all research be demonstrably useful, then we are going to destroy the basis of inquiry and the acquisition of new fundamental knowledge, and, as

you know, occasionally basic research turns up something terribly useful.

The Chairman: I am going to stop this seminar right now.

To come back to the substance of these two paragraphs, I am always worried by two things. First of all, that by putting all the emphasis on major or so-called major programs or projects we may forget the little science and we may forget the little technology, and I am not seeing very many studies by the council dealing with these issues—little science, yes, but much less about little technology and small innovations which very often are more practical than major projects. Secondly, while I have been seeing the Science Council advocating this approach of major programs, I have never seen really a list of criteria by which these major programs would be selected. I am always afraid to have a repetition. You mentioned here the Atomic Energy program which fortunately was successful, and for obvious reasons. But I always remember the Arrow, which was unsuccessful and for reasons which should have been obvious but were not obvious. So it seems to me that in your approach to this selection you should perhaps put a little more emphasis on little technology and also to the criteria of selection for the major programs.

Dr. Kates: I believe as far as criteria are concerned that we have stated four, Mr. Chairman. I seem to recall that it should be of relevance to national objectives that there be a distinct Canadian problem, so that we do not simply duplicate others. I believe you will find more than half a dozen criteria outlined in addition to a shopping list of problems to which major programs would address themselves. However, you may feel that our criteria were not sufficiently specific. Perhaps your criticism is directed at that.

The Chairman: Especially in view of the market possibilities, because this was the obvious problem with the Arrow, and especially because of the fact that we have a neighbour which is devoting approximately \$35 billion every year to R&D.

Dr. Kates: If you look at both the criteria and the shopping list, I believe you will find that there was a stronger preference to address oneself to major Canadian problems on which the various sectors in Canada, in any case, were going to spend a great deal of money. I believe that in 1968 we pointed out that energy would be a very good subject for a major program in this country. Perhaps if it had been undertaken we would not have the problems which we face today. So I think perhaps your criticism may refer to the list of criteria, or specifically—

The Chairman: Or, perhaps, a re-statement to refresh our memories.

Mr. Shepherd: In the energy summary, which was published in March 1975, we have defined the four criteria for a major program, so we have upgraded that review within the last year.

Dr. Kates: Turning for a moment to small science and small technology, we are sympathetic to what you say, Mr. Chairman, and our industry committee is most likely

specifically going to consider the question of support for small-scale technology, small science and small industry, and we will probably develop a stance on that subject.

Mr. Shepherd: I might also add, Mr. Chairman, that in "Innovation in a Cold Climate", which was the best-known of our reports, we specifically devoted time and effort to analyzing the problems of Canadian companies.

The Chairman: Yes, I remember that one, and nothing was done about it. This is not criticism of your activities or your report.

Dr. Kates: Remember that my opening statement referred to the change in the Industrial Development Bank.

The Chairman: As far as I am concerned, I have many other questions, but I will not ask them today. However, I am worried about the condition of our statistics in relation to R&D, especially the adjustment factors, the sophistication factor and the price factor. You cover this in paragraph 45, and, of course, I am astonished that the National Research Council has taken the time to adjust these figures with the Consumer Price Index, which is a very bad deflator for such an exercise. You say, of course, that this was a very crude adjustment, but I wonder if you should not have mentioned also that Statistics Canada should take the initiative in this area, because they have much experience in building deflator indices for various purposes. It seems to me that rather than MOSST taking the initiative, as you suggest here, for that type of very important operation, perhaps Statistics Canada could do a better job.

Mr. Shepherd: If I may offer one correction, I thought I heard you say that it was NRC that had used the Consumer Price Index. It was, in fact, MOSST. A rather more sophisticated method was used by the NRC.

Dr. Fortier: Mr. Chairman, I would like to direct the issue of correcting factors and so forth to one of our experts on the subject, Jorge Miedzinski. In terms of the apparent discrepancies between the percentages which appear in our brief and in my opening statement, with your permission I would ask Jorge Miedzinski to offer some comments on this issue.

The Chairman: I am sorry, doctor; we have only four or five minutes left. I know that the council is very much interested in this and I agree completely with this interest and concern. In my opinion, if we had started some years earlier to endeavour to deflate the dollars we were spending for R&D we perhaps would not have created the impression that these amounts were increasing all the time and every year. However, it seems to me that the expertise of Statistics Canada should be brought in at some stage, if we are to improve the system.

I have many other questions, but we could stay for weeks and weeks. I wish to thank you very much on behalf of the committee. If you have any other communications to make we would be glad to have them, as I believe we are fighting for the same objectives.

I am very glad that you have been able to spend all this time, together with your colleagues, with us, not only today but on two previous occasions. Thank you very much.

The committee adjourned.



FIRST SESSION—THIRTIETH PARLIAMENT
1974-76

THE SENATE OF CANADA
PROCEEDINGS OF THE
SPECIAL COMMITTEE OF THE SENATE ON
SCIENCE POLICY

The Honourable MAURICE LAMONTAGNE, P.C., *Chairman*

Issue No. 11

WEDNESDAY, MAY 12, 1976

Eleventh Proceedings on:

The Study of Canadian Government and
other expenditures on scientific activities
and matters related thereto

(Witnesses: See Minutes of Proceedings)

THE SPECIAL COMMITTEE OF THE
SENATE ON SCIENCE POLICY

The Honourable Maurice Lamontagne, P.C., *Chairman*

The Honourable Donald Cameron, *Deputy Chairman*

and

The Honourable Senators:

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Carter	Rowe
Giguère	Stanbury
Godfrey	Thompson
Goldenberg	van Roggen
Grosart	Yuzyk
Haig	

27 Members

(Quorum 5)

Order of Reference

Extract from the First Report of the Special Committee of the Senate on Science Policy, presented on July 10, 1975 and printed as an Appendix to the Minutes of the Proceedings of the Senate of that day, and adopted by the Senate on July 24, 1975:

"The Committee, therefore, recommends that it be authorized to consider and report on Canadian government and other expenditures on scientific activities and matters related thereto;

That the Committee have power to engage the services of such counsel and clerical personnel as may be necessary for the purpose of the inquiry;

That the Committee have power to send for persons, papers and records, to sit during adjournments of the Senate and to report from time to time; and

That the Committee be authorized to print such papers and evidence from day to day as may be ordered by the Committee."

Robert Fortier,
Clerk of the Senate.

Minutes of Proceedings

Wednesday, May 12, 1976
(20)

Pursuant to adjournment and notice the Special Committee of the Senate on Science Policy met this day at 3:37 p.m., the Chairman, the Honourable Senator Lamontagne, presiding.

Present: The Honourable Senators Bell, Bourget, Cameron, Carter, Godfrey, Grosart, Lamontagne, Lang, Neiman, Rowe and Yuzyk. (11)

In attendance: Messrs. Philip J. Pocock, Director of Research, and Jacques W. Ostiguy, Chief of Administration.

The Committee proceeded to the consideration of its Order of Reference dated July 24, 1975 relating to the study of Canadian Government and other expenditures on scientific activities and matters related thereto.

The following witnesses from the *Department of Industry, Trade and Commerce* were heard:

The Honourable D. C. Jamieson, P.C.
Minister;

Dr. Sydney Wagner,
General Director,
Office of Science and Technology;

Also in attendance:

Mr. Lubor F. Drahotsky,
Assistant Deputy Minister,
Industrial Policies.

Mr. Jamieson made an opening statement. The witnesses then answered questions put to them by members of the Committee.

At 5:33 p.m. the Committee adjourned until 3:30 p.m. Wednesday, May 19, 1976.

ATTEST:

Patrick J. Savoie,
Clerk of the Committee.

The Special Committee of the Senate on Science Policy

Evidence

Ottawa, Wednesday, May 12, 1976

The Special Committee of the Senate on Science Policy met this day at 3.37 p.m. to consider Canadian government and other expenditures on scientific activities and matters relating thereto.

Senator Maurice Lamontagne (*Chairman*) in the Chair.

The Chairman: Honourable senators, I am sure we are all pleased to have the Honourable Mr. Jamieson, the Minister of Industry, Trade and Commerce, with us this afternoon. You will recall that at our last meeting there was some hesitation on our part to put policy questions to the officials; we did not wish to embarrass them unduly. I can remember the famous expression attributed to Mr. Pickersgill that civil servants were emanations from ministers and should not comment too much on policy questions.

Senator Grosart: Ministers are sometimes emanations of civil servants, too.

The Chairman: Don't speak on that area, because you have no experience yet.

I understand, Mr. Jamieson, you have a prepared statement, and I am sure all honourable senators will be glad to hear you, sir.

The Honourable D. C. Jamieson, Minister of Industry, Trade and Commerce: Thank you very much, Mr. Chairman.

Honourable senators, I thought it might be advisable for me just to make a brief opening statement as a focal point for the discussion, but without any thought that it should be inhibiting in any way if there are matters which are not covered in the statement but with which you would want to be concerned.

I should say before making the statement that I welcome this opportunity for a very good reason, namely that, like yourselves, I am at the moment very much involved in trying to determine just exactly what the role of industry, trade and commerce ought to be in the field of research and development and related matters. Therefore I not only have an open mind, but I have a receptive one for any positive proposals that might come forward.

Having said that, let me just say that I am pleased to have this opportunity to appear before you. I am, of course, aware by reputation of the work of this committee and of the substantial contribution which you, Mr. Chairman, and your colleagues are making to the important national debate on science policy.

I am informed that my officials have already appeared before you on two separate occasions and that they have dealt with a wide variety of operational and administrative matters. In addition, I am told they have responded to

many of your questions relating to the recommendations concerning my department which arise out of your earlier reports. Therefore, my purpose today is to deal more particularly with those aspects of industrial science and technology which are matters of government policy. Specifically, I understand that your interests lie in the following areas and that broadly speaking they can be summarized by the following three questions: One, is the government satisfied with the innovative performance of Canadian industry? Two, is the government satisfied with the impact that my department's programs are having on Canadian industry? And, three, what are the future government plans in the field of technological innovation?

On the first point I may say simply, no, we are not completely satisfied. In fairness, however, I must hasten to add that we will probably never be fully satisfied. Nevertheless, one should not exaggerate the situation. It is necessary, in my opinion, to put this issue in a proper perspective. Frequently the starting point to measure Canadian industrial innovative performance is taken to be the percent of the GNP expended on R&D. In this connection attention is usually drawn to the fact that we in Canada are not among the world leaders, namely the U.S., U.K., France and West Germany. However, as you are aware, we do rank with Japan and Sweden.

At this point I know you will remind me that the proportion spent in industry is less in Canada than in other countries. There may be a larger percentage in other categories, but in industry it is less. This is correct, but in attempting to establish the meaning of the statistics the following factors must be taken into account, and I am sure we will elaborate on this in the questioning:

(A) At the outset we start from the premise that no company should undertake research for its own sake. R&D must contribute to company profits. It must make sense in terms of the company's overall plans.

(B) The ownership of Canadian industry is such that it has relatively easy access to much foreign technology. Hence the actual statistics tend to understate the true level of technology in Canadian industry. While I would be one of the first to agree that we must not allow ourselves to rely exclusively on foreign-owned subsidiaries for our industrial technology, we should nevertheless remember that they account for about 55 per cent of the industrial R&D expenditures in Canada.

(C) The structure of Canadian industry is very different from that of other countries. Hence Canadian requirements for industrial R&D are also different. Thus, a single number index, namely the per cent of GNP expended for R&D, may not be valid for purposes of comparison. To illustrate the importance of looking in more detail at the Canadian economy rather than trying to characterize it by one number, I refer you to the following sectors: paper, petroleum, rubber products and non-ferrous metals, in

each of which the level of R&D in Canadian industry is equal to or significantly higher than it is in the United States.

(D) Finally, no one to date has been able to develop—and this is a most interesting point—an acceptable correlation between expenditure on R&D and innovative and commercial performance.

In this connection I should draw your attention to the relative industrial performances of the United Kingdom and Japan, in which Japan by all yardsticks that are available appears to be considerably out-performing the U.K. despite lower expenditures on industrial R&D.

Allow me to refer to a talk given recently by Sir Alan Cottrell, who is the retired chief scientific adviser to the United Kingdom cabinet, a distinguished scientist and a man who has for many years been actively involved in the industrial application of technology. He is highly critical of the level of assistance which the United Kingdom government has been trying to force on British industry. Those are his words, not mine. Sir Alan comes to the conclusion, based on a lifetime of experience, that 0.5 per cent of GNP invested in R&D in industry would be a realistic level for the United Kingdom. In other words, significantly less, indeed, than is being spent at the present time.

I do not wish to make a comment at this time for or against this particular recommendation. I do simply want to sum up on this point by saying that in so far as innovative performance of Canadian industry is concerned, it is influenced by a variety of complex factors.

In talking about the next point, namely the impact of departmental programs, this, too, must be put in suitable perspective. The first thing to note is that the magnitude of all R&D assistance programs is about \$100 million a year. This must be compared to that which industry itself spends, which is about four times that amount. That is, in all sectors the governmental participation is \$100 million, and what might be described as "everything else," is some \$400 million.

I think you will agree that the expectations which we can reasonably have for our programs must not only be related to the amount of our expenditures for technological development but must also bear a relationship to the overall size of the secondary manufacturing sector, which was, by the way, \$56 billion in 1975. Having regard to the magnitude of our government expenditures, I think that relatively speaking we have had many successes—but in assisting smaller Canadian companies as well as influencing the multinationals to rationalize and to give international product responsibility for production and development to their Canadian subsidiaries. In this latter connection I might mention, for instance, (a) a new family of computers is being developed by Control Data Corporation; (b) equipment for working on underwater oil and gas wells by Lockheed Petroleum Services; (c) a large air-cooled automotive diesel by Deutsch Diesel; (d) a family of gas turbine engines by United Aircraft; and, (e), a doppler radar by Marconi—probably the best known of those being the United Aircraft gas turbine or "PT-6", as industrial people will know it.

Furthermore, to date total sales being generated by projects under these programs have far exceeded government expenditures, and in this context you will find further details in our departmental submission.

Of course, my department is also involved in the technological innovation and the promotion of industrial R&D which is fostered through the procurement requirements of other government departments. I refer, for example, to:

- (a) satellites for communications and exploration; and
- (b) instrumentation and components for nuclear reactors.

In concluding the discussion on this point for now, I would summarize by saying that there are three principal kinds of government technological assistance to industry. These are:

- (a) Responsive. In this situation government provides assistance to a company for the exploitation of a market opportunity which is identified by the company itself;
- (b) Directive. The government helps to identify a market opportunity and, in addition, helps the company with the cost of developing the technology; and
- (c) providing a market to industry for government requirements.

I suspect you will wish to comment and ask questions with regard to government purchasing, because it is an area in which there is a fair degree of mythology on both the negative and the positive sides. I think the truth is somewhere in between most of the comments we have heard with regard to the leverage that government procurement can provide.

The third topic I would like to explore with you is, where do we go in the future? For example, should the government interfere more directly in the process of identification and selection of opportunities for industry? I must confess that in this regard we are inclined to move very cautiously. We are not aware of any formula in terms of which we can, in a foolproof manner, develop either a global industrial strategy, or sectoral strategies, for that matter. Indeed, our impression of this type of activity, as practised in other countries, is that it has frequently been less than successful. In fact, the record is not such as to instil confidence in the superiority of bureaucratic judgment as compared to that of the businessman. Nevertheless, we are embarking on a systematic examination of several industrial sectors, with a view to identifying potential industrial and technological opportunities.

In addition, the government is giving priority attention to particular fields where government leadership is needed in order to produce the required results. I refer particularly to the sectors of energy, space and the oceans. These fields, as I know you are all well aware, will have important potential consequences for industry.

Concurrently we have embarked on a series of other actions which are now in progress, and which will also have important implications for technology and industry. These are, first, a review of our own departmental programs, and I might say here, parenthetically, that I had my first exposure to the initial report on this earlier this week. I will be more than pleased to give you some of my initial impressions of it, and some indication of what the report contains. I should also add that it is my intention, once I have had an opportunity to examine the report in detail, to make it available publicly, because I think it is a good basis on which to continue the debate concerning the kind of initiatives that we should be undertaking in industry, trade and commerce.

The second area I wish to mention is the government's "make or buy" policy, to which I have already referred, and on which I will be pleased to elaborate later.

The third area is that of the role of Canadian Patents and Developments Limited, or CPDL, the government agency which promotes the commercial use of government and university patents, to determine whether or not its mandate should be broadened.

Finally, I wish to refer to the situation with regard to venture capital for the start-up of new small businesses.

These are all studies that are under way, and which are in various phases of completion. The two about which, as I said, there has been the most conclusive evidence to date, are the "make or buy" program and the value or otherwise of the existing range, broadly speaking, of the research and development programs that we have.

Those, Mr. Chairman, are just some opening remarks that I thought, as I mentioned at the outset, might focus the discussion. Having been on committees myself, I know that it is far more interesting to be asking questions than listening to long spiels from ministers. I shall therefore do that, and do my best, also, along with my officials, to answer any questions you may have.

Senator Godfrey: The report you are talking about is the one Gordon Sharwood was involved in, is it?

Hon. Mr. Jamieson: Yes.

Senator Godfrey: That is in now, is it?

Hon. Mr. Jamieson: I have what I might describe as a sort of advance draft. Mr. Sharwood has to do some additional work on it, but he gave me a full exposition of it earlier this week, and it is quite an impressive document; but that is the report to which you refer, yes.

Senator Grosart: This would be the basis of the new policy that is being talked about so much, the new industrial strategy?

Hon. Mr. Jamieson: No, I would not see it as embracing total so-called strategy. It was essentially a mission assigned to him with the object of examining the whole range of research and development related programs which we have in the department, many of which may very well be outdated, or need updating, or perhaps even cancellation, and substitution of some new approach for them. That is the focus of his examination, and it is on that that he has prepared this report.

Senator Bourget: Was it only concerning industry, or also universities?

The Chairman: Only grants to industry.

Hon. Mr. Jamieson: From the Department of Industry, Trade and Commerce, although in the process it became inevitable that he would look at, for example, regional development policies as they apply to industry and to certain elements of agriculture in terms of that sector's industrial side; so it is not just the programs administered within the department that are dealt with but those also within the whole spectrum of government activity.

Senator Cameron: When do you expect the report to be available?

Hon. Mr. Jamieson: I would think relatively soon, senator. I think I can say that I would hope to have it out

before the summer recess, if possible, if we can get the publishing and translation completed in that time. I might say, in the interests of frankness, that I have two decisions to make here. One is to issue the report without indicating what action we are proposing to take on it, and at the same time inviting comment. The other is to issue the report along with my initial reactions, but also indicating that we are prepared to hear submissions. It is in the making of that kind of decision that I am engaged right now.

Senator Grosart: What relationship, Mr. Minister, would this have to the proposals presented to the cabinet for a new industrial development policy, last year? Is this a study of the proposals? Or what is the relationship between the two?

Hon. Mr. Jamieson: Perhaps I can answer you best by elaborating slightly on the so-called industrial policy to which you have referred.

As you know, it was decided a couple of years ago that it was not practical to seek to devise what might be described as an industrial strategy, using the word in the singular, but that a more practical approach would be to identify certain key sectors of Canadian industry, and to seek to determine what the wisest approach would be in these individual sectors; because they are quite different, in the sense that what one does in the textile field may be significantly different from what one does in the automotive field. That is the report to which I think you are referring. Research and development, of course, is very much connected to that, because what we decided to do in terms of support for research and development within the department will have a bearing or whether we put money into supporting, let us say, the automotive industry, or whether we decide that the automotive industry is big enough to look after itself in the field of research and development and various other sectors. Once we know what the policies ought to be in terms of support for research and development, we then can channel that support to the specific places in which, in our collective judgment, they will do the most good.

Senator Grosart: When will we hear something about this new industrial development policy?

Hon. Mr. Jamieson: I do not expect that it will be in a single declaration on tablets of stone, as it were. I think a number of things have started to come out already. The textile policy, for example. We have, in that sector, made certain determinations which are now being followed up. I think what you will see is, over a period of time, a number of reports, or policy statements, for specific sectors, such as the automotive field. You may know that I met with the Honourable Elliott Richardson, the Secretary of Commerce of the United States, and we advanced substantially in terms of the kind of strategy we ought to have, not only in Canada, but in the continental sense, with regard to the automotive industry. Also, certain things on energy are emerging from various discussions with the provinces, and so it goes on. It will, therefore, I think, be more of a moving and progressing approach, rather than any one declaration of policy.

Senator Grosart: This seems to me to be rather different from what one would have expected from the description of the industrial development policy given in the presentation made by the department to this committee, which is as follows:

30. These industrial policy proposals:

- a) defined the role which the federal government ought to play in industrial development and proposed a set of industrial policy goals;
- b) identified the major factors which will have a bearing on Canadian industrial development over the next decade. Among these factors are the rate of technological change and the need to improve the technological performance and capability of Canadian industry;
- c) outlined a framework for the development of policies and programs which would be responsive to the specialized needs of individual industry sectors;
- d) identified a need for a more coherent approach to industrial development policy . . .

. . . and so on. This sounds a little more like strategy approach than the "bits and pieces" approach you have just indicated.

Hon. Mr. Jamieson: Well, I suppose, it is a matter of semantics. The strategy can be made up—I would not accept the definition of "bits and pieces",—sectorally, and I am simply saying that realistically one has to expect that one would have to deal with these industries in a sequence or on a one-by-one basis rather than trying to roll them all into one single kind of declaration of what we are intending to do in terms of an industrial strategy. But I think the correlation between what I have said here and this is really, as I understood it, that the main concern of this committee at this moment is research and development, and in that sense the R&D would indicate whether it was a good opportunity in a particular sector for advancement or whether we should be bothering with a particular segment at all.

Senator Grosart: Mr. Minister, R&D is part of the concern of this committee, but it is a committee on national science policy which goes much beyond R&D and brings us right into your department. It certainly takes us to the technology side of it. What concerns us here is that we are faced with these dramatic statements that we are on the brink of disaster. We had the Science Council before us last week and we were told that another three years of present government policies means that the Canadian scientific capacity is destroyed. We asked, "Do you mean destroyed or just damaged?" And they said, "destroyed". This was supported by the witnesses from the Science Council. This is what concerns us, that we are faced with three years of present policy and our capacity is destroyed according to the Science Council of Canada. And the weaknesses are so apparent that I am sure that this committee would like answers from you if possible on what is going to be done about these weaknesses. The first, of course, is the steady decline in constant dollars in the funding of science and scientific activities by the Government of Canada. Is this doing to be reversed? We have had four years of this situation and the Science Council now tells us that in another three years our capacity will be destroyed.

Hon. Mr. Jamieson: Well, I would think that most of those representations, and I don't want to take issue with them, are not related to what, as I understood it, you wished to have from me, namely our support of research and development in the practical innovative sense of supporting industry. I must confess to you, and I am sure you would readily recognize it, that I am not really competent to judge and, at this particular moment, to assess the whole scientific policy or lack of it, but I was referring primarily to my responsibilities. Those are to ensure that we are as

competent as we possibly can be in the very practical sense which I mentioned earlier of relating research and development and how we can improve exports, productivity, profitability of business and industry of this country.

Senator Grosart: That is practically the whole ball game, of course, and it is to that point that our criticisms are directed.

Hon. Mr. Jamieson: I did not understand that that was the main thrust of the Science Council's representations.

The Chairman: I think, to be fair to the minister, Senator Grosart, we have to recall that the vice-chairman of the Science Council was referring mainly to assistance by the government to universities.

Senator Godfrey: That certainly was the way I heard it.

The Chairman: So I agree that this particular crisis does not directly concern the minister.

Hon. Mr. Jamieson: I might say in seeking to be helpful to Senator Grosart that we of course do have some input into university research and in non-industry research, but we are not the main instrument through which that kind of objective is pursued.

Senator Rowe: Mr. Chairman, of that \$100 million mentioned earlier as government input, and most of it, I take it, through your department, would some of that be going into the universities?

Hon. Mr. Jamieson: A relatively small percentage—just one or two million of that particular amount. The rest of it is by decision and by conscious action directed toward industrial research within companies.

Senator Bell: Mr. Minister, it might be helpful if you could tell us briefly what your mandate is. We know that it is the Department of Industry, Trade and Commerce and we know that research and development comes into it. But could you describe in a one-sentence statement what your mandate is as minister?

Hon. Mr. Jamieson: Well, I suppose it is to keep the business community and the wheels of industry turning as best we possibly can with a strong emphasis on export trade, import replacement and various things of this kind, and to be, within the general responsibilities of a minister, the spokesman for the business community within Canada and within the councils of government. It is not a very precise definition, but I regard myself in the same way as the Minister of Agriculture considers himself to be the spokesman for a special interest group. My job is to make sure that the views of the business community and the manufacturing community are conveyed accurately to my colleagues in cabinet.

The Chairman: You have not developed your own Mrs. Plumptre yet?

Senator Bell: Well, following from that, where would you pledge your priorities as minister as between trade, commerce, the business community and so on? What are your priorities where research and development are involved?

Hon. Mr. Jamieson: Once again that is a very big question to try to answer, but to try to give you a succinct answer I would think that given this moment in our history and the problems we face, that anything that improves our export performance or that makes us either

more efficient or more attractive in terms of the goods and services we produce around the world would have to be very, very high on my list of priorities as of this present moment. Similarly, and being very pragmatic about it, I would also have to say to you in terms of our present financial situation and the economic condition in the country that if I had to opt to give support to something which would produce results within the next year or two as opposed to something ten years down the road, I repeat that in the present circumstances I would have to put the emphasis and the major amount of my attention on what I regard as being the most essential problem, namely, to get those figures up and to get the balance of payment situation turned around as fast and dramatically as possible.

Senator Bell: I have here a quote from Dr. Tory, the founder of the National Research Council and he thought that if a department were set up in the federal government which was called "Science, Industry and Commerce", it could in a few years be made to mean more to industry than all of the petty tariff changes about which there is so much agitation. Now that is bringing it rather closer to home.

Hon. Mr. Jamieson: Well, I am aware of this school of thought but I am not certain that I share it. I do not share the idea that the Department Industry, Trade and Commerce should be the repository of almost the total assignment for research and development and perhaps even some of the various other and more esoteric forms of scientific research including, for example, fisheries research and the like. If senators wish to explore it with me, I will be glad to go into it in detail. A short answer is, however, that it is very rare that a particular research facility, as I understand it, is not carrying out a large number of functions and it would be very hard, so far as I have been able to see, to determine what parts of those functions were legitimately related to industry, trade and commerce and what were related to other fields. So it is a good basis for an argument or discussion as to how centralized the authority ought to be. I am tending at the moment to go in the opposite direction.

Senator Carter: My question is related to Senator Bell's question. The answer which the minister gave to an earlier question in which he gave the broad picture of the problems facing our country, high unemployment, a declining balance of trade, trade deficits, export problems, bring me back to his statement about a strategy, that is to say a sectoral strategy rather than a global strategy. When I talk about strategy, I am thinking in terms of the context of that whole picture, the picture of the problem facing our economy.

Your department does not have the whole mandate to cope with all these problems, but it has an important part to play. What I think we would like to know is what other departments are doing, where you fit in, in your particular niche, in this overall strategy to cope with these problems. We would also like to know what specific problems you are zeroing in on now as part of your share of or assignment in this particular strategy. I am thinking particularly of high technology. We have had evidence before another committee, of which I am a member, that there has been a serious decline over a period of years in high technology exports from Canada. Here is a specific problem. What is your department doing along these lines?

Hon. Mr. Jamieson: Perhaps honourable senators will be patient if I give a fairly lengthy and comprehensive

answer, because that is not something I can answer in one or two sentences. You asked a number of things rolled into one.

Dealing first with relationships with other departments, let me take fisheries, which will be familiar to you, and certainly to my other fellow Newfoundlander here, Senator Rowe. In trying to determine what the policy or strategy ought to be on the industrial side of fisheries,—this relates also to your question about the problems—one difficulty across the spectrum is the way in which jurisdiction is divided. In other words, there is a good deal of provincial input and some significant portion of federal input. That can be said for almost every field to which you may be addressing yourself.

Fisheries Canada, the federal department, has the overriding responsibility. However, there is the closest co-operation between us in matters such as what the market potential will be. Fisheries does not have, nor should it have in my judgment, a capability beyond a consultative one in determining the foreign markets for such a type of production or a proposed new development in fishery products, something of this kind. This is where they rely upon us, and our research people around the world seek to determine that kind of thing.

I am new enough there not to be prejudiced in this respect. In my opinion, we are also very competent in seeking to determine the market potential for new products, and I am very much impressed with our people around the world in this connection.

Continuing with the fisheries analogy, when companies come forward with innovative ideas or concepts that they wish to develop, we are in a very good position, in consultation with Fisheries, to make a determination with respect to, for example, one of the things we are working on now, which is shredded salted cod as a practical product for the Caribbean. We think it is; we think it has a very good market. We think it will result in a distinct improvement in the yield from a fish; in addition to the fillets, getting the balance of off-the-bone, as it were. We are in the process of providing research funds so that a particular company can do R&D on that kind of program. I just use fisheries as a simple example.

Overall, when you talk about the high technology industry and whether or not we are declining in our exports in that respect, it is very difficult to measure that. I would like to see the contention that it has declined spelled out. That is not my own impression. I believe we have had a problem in this country in trying, in a sense, to be all things to all people in high technology. In other words, there has been a tendency to assume that we can get into practically everything that emerges, whether it is computers, aerospace, or whatever it happens to be. Therefore, when one looks at the faults in our programs it can be seen that, I think it is fair to say, we have been spread too thin and have not really developed yet what, in my judgment, is worth looking at very hard, which is the centres of excellence, what are the things Canada can do, where it has a unique capability, where we are not going into a market that is already being very heavily pressured by some very highly developed countries such as the United States, Japan, the European Economic Community and the like. We therefore have isolated such things as STOL (short take-off and landing) aircraft; we have isolated out a number of things of that kind.

One of the questions we have to ask ourselves, given limited resources, is: should we in fact be encouraging all

forms of R&D in this country or should we be saying that we should, in a sense, to use a down East expression, but using the rifle instead of the shotgun? This is the sort of thing with which we are grappling at the present time to try to determine how we can get a better focus. It depends on which way you want to go at it.

In our department, whatever other priorities there may be in other departments in other areas, I can have only one interest and one concern as the Minister of Industry, Trade and Commerce, and that is: is the R&D going to be related to greater profitability, greater productivity, greater sales? Those are the primary things with which I must be concerned. It is not enough that somebody has a marvelous concept and it would be nice for Canada to have a particular kind of competence. It seems to me that it is for some other ministry or department to judge that. Mine is a very hard-nosed, hard-headed approach to the use of research and development funds.

I am sure I have not covered all your points, but I do not want to bore honourable senators by going further.

Senator Carter: I would like to follow that up with two observations.

The Chairman: I think our questions should be shorter and more to the point of our inquiry, and not as general as they have been recently.

Senator Carter: The minister says we should be more selective rather than trying to do everything that is available. I agree with that up to a point, but I think the minister will recognize that, in the face of our unemployment problem, the biggest source of jobs is in the high technology field. Therefore, we must somehow or other make a selection of the type of R&D that is likely to pay off with jobs.

Hon. Mr. Jamieson: With the greatest respect, I think that statement is suspect. I am by no means convinced that high technology, continuing research and development, improvement and innovation will have a direct impact on easing unemployment. In fact, if you want to expand the discussion to talk about productivity, it is perfectly clear that the dilemma we face in this country is that about 75 cent of our research money of one kind or another, and support funds, is going into various activities which tend to retard productivity because they do not let the normal kinds of forces take their course. In other words, innovation and high technology tend to be to develop equipment, machinery and the like, which actually can be job replacing.

The Chairman: Or new products.

Hon. Mr. Jamieson: Or new products.

Senator Carter: New products and new technology are a source of new jobs. You also mentioned the gas turbine produced by the Montreal company, which is used in the LRC train. That is a Canadian product which has tremendous potential.

Hon. Mr. Jamieson: My recollection is that it is the turbo train.

Senator Carter: Yes, the turbo train. We need it in Canada, and other countries are interested. What are we doing? There would be a good source of jobs if we could make that industry viable. What is your department doing?

Hon. Mr. Jamieson: This is, once again, a very fascinating kind of question. However, with respect to your other point as to new projects, remember also that new projects imply in the great majority of cases replacement. In other words, if something is new and comes along and puts something else off the shelves or off the market, again it is not a 100 per cent gain.

Senator Grosart: Yes, so you must be against the ballpoint pen.

Hon. Mr. Jamieson: If it meant that I would not have to sign quite so many documents, I would be.

Senator Grosart: It meant that we do not have fountain pens any more, but those who innovated the ballpoint created a lot of jobs.

Hon. Mr. Jamieson: Let me make you up on that point, senator: I am not against the ballpoint pen; I am against someone in 1976 in Canada spending a great deal of money because he thinks that he can develop a new type of ballpoint pen when 40 other countries have had a very big head start on us. Therefore, that is the distinction and the difference I am making. However, I was attempting to answer the senator with respect to another point.

Senator Grosart: But the word we are discussing is "innovation"; innovation is not coming up with something that 40 other countries have, Mr. Minister.

Hon. Mr. Jamieson: That is exactly why the ballpoint pen analogy is completely phony in this regard.

Senator Grosart: Well, that is your opinion.

Hon. Mr. Jamieson: However, do I answer Senator Carter's question?

The Chairman: Yes.

Hon. Mr. Jamieson: I was going to say that the LRC train is a pretty good example, as is the turbotrain. We put a tremendous amount of money into the turbotrain through the Ministry of Transport and the Department of Industry, Trade and Commerce, but up to date at least it has not been anything that has won wide acceptance outside Canada. We now have the LRC—light, rapid, comfortable—which is the new development. Here, once again, you talk of poor services. The situation is likely to emerge here that we will have to decide on the employment of that train in Canada as a matter of national policy in terms of a new train before we will be able to get anything by way of export orders. This is where there must be a very close correlation between the Ministry of Transport and ourselves. For my own part, I have argued that the railways should certainly be encouraged to use the LRC. Once it is in work in Canada and there is a production line running, in my opinion there will be a very good chance that we can sell it in the United States and in some other countries. However, it must be developed and put into operation in Canada first and we have put a very sizable amount of money into that.

Senator Cameron: What degree of cooperation has there been between Canada and the United Kingdom with respect to this light fast train?

Hon. Mr. Jamieson: To the best of my recollection, not very much.

Senator Cameron: Because they have a very good light fast train.

Hon. Mr. Jamieson: This, again, is the other point, which comes back to Senator Grosart and his ballpoint pen approach. Take urban, or inter-city transit; the question of whether or not we should be spending a great deal of money to develop the LRC type train in Canada, or whether we should be looking at the technology of other countries and buying the technology as opposed to seeking from the outset to develop our own kind of train, leads me to consider that in the case of the train we are probably on the right track.

The Chairman: I hope so.

Hon. Mr. Jamieson: That is right, literally and figuratively. However, I think it was basically a North American and largely Canadian consortium that put it together, rather than the United Kingdom. There is a movement under way at the moment by which we would pick up for the city of Toronto trams which, I believe, are of Swiss manufacture and design and modify those within the country. There are those who say: "Why should we not start and develop our own tramcar?" I am back to the argument where I believe that would be an unwise and unnecessary expenditure in the first instance.

Senator Godfrey: When you talk about the necessity before you gave grants to industry to show that it would improve profitability, production, and so on, I am also interested in the question as to whether or not industry would have gone ahead on their own in any event and are ripping off the government.

Hon. Mr. Jamieson: I suspect that there is a measure of that. One of the questions we must decide is whether we must have universality in our programs, which is what many of them have and which the IRDIA program, which we are phasing out now, had. That is as long as the criteria were met the title to a grant was automatic. In that kind of arrangement I have no doubt that a certain number of companies, particularly the big companies, found perfectly legitimate means but, nevertheless, found the means to get the government to support programs that they would have carried out on their own. If one looks at the comparatively narrow number of larger companies which received very significant amounts of money over the last decade or so, I think it tends to bear this out. You will hear all kinds of arguments that this is not the case, but it is not a provable proposition.

Senator Godfrey: Is Gordon Sharwood considering this question?

Hon. Mr. Jamieson: Yes, very much. For the reasons I mentioned, if there is any failing in this it is the fact that we have done very little for the smaller companies in this country and too much, in my judgment, for the multinationals.

Senator Godfrey: I might say by way of comment that your opening statement struck a rather responsive chord with me when you referred to forcing R&D. The expression I have been using is ramming it down their throats, but it is the same thing.

Senator Grosart: Mr. Chairman, first of all I would like to correct the impression that has been given. That statement with respect to Canada's capacity for basic and applied research being destroyed was not limited to universities, as you will find in paragraph 31 of the brief submitted by the Science Council of Canada.

The Chairman: I was referring to Dr. Fortier's remarks.

Senator Grosart: The exact phrase to which he was referring is here, reading as follows:

... Canada's capacity for basic and applied research, which requires decades of painstaking development, but can be destroyed within a few years.

It was in response to questioning on that that he said three years and this is not limited in any way to universities in the statement. Because it refers to R&D, it is particularly interesting in connection with the minister's department, for the simple reason that the largest part of its expenditures in this area are on R&D, being something in the order of \$97 million out of \$104 million. Secondly, because out of all the departments it has the largest percentage of extramural expenditure. So we are talking of this being the same thing, that is the application of R&D and innovation to the objectives which the minister has outlined. That is why I am somewhat disappointed to hear him attempt to downgrade the importance of R&D in the end result, because all the evidence we have had for five years in Canada and elsewhere is that unless the R&D capacity is maintained innovation just cannot take place. It is quite true that we will have to import 98 per cent of our technology, but we cannot import it unless we have the R&D capacity. That is what they are talking about and that is why I said at the opening that we are concerned about downgrading of expenditures in science activities generally and R&D in particular. That is why I asked if there is any hope that the government's continuing decision as far as you know and as far as your department is concerned, Mr. Minister, is going to be reversed? That, I think, is the essential question in this whole area in Canada today.

Hon. Mr. Jamieson: Let me first of all clarify something. I obviously was not adequate in my answer or clear enough in my expression of views. I certainly do not wish to leave with you or with the committee any impression that I downgraded R&D. In my opinion research and development is tremendously important and I have no quarrel with any quotes that say it is an essential element in industrial strategy. The answer I gave had to do with the selectivity of the use of R&D and I quote again from my opening statement, how much of it we can absorb practically and in a profitable and gainful fashion. There has been no downgrading within, for instance, my ministry. Indeed, one of the things that has emerged is that in every one of the last five or six years and, I believe, without exception there has been less call by industry on the funds that we have had available than we would have expected, or we would have liked. This, and I refer you again to my opening remarks, raises the question as to whether we should be more initiating in our activities, or simply be responsive in simply waiting until industry comes to us.

The Chairman: Is this why you have cut IRDIA?

Hon. Mr. Jamieson: That is one of the reasons, sir.

The Chairman: No demand for funds?

Hon. Mr. Jamieson: I would not say that there was no demand for funds; there was a substantial demand for funds and I believe approximately 1,000 companies, in one way or another, have taken advantage of that program.

We simply did it, first of all, because we had doubts that that was the most effective way of going at it; primarily because of Senator Godfrey's comment that it is universal

and non-discriminatory, in the sense it goes out automatically.

The Chairman: You reached a decision on that before the review was completed.

Hon. Mr. Jamieson: Yes, indeed, because I think that one was pretty obvious, and one of the things that led us to review all the programs.

In other words—the final point, in response to Senator Grosart's comment—there has been no reduction in the total effort on our part. If we can find a better mechanism of doing it—I hope your report will suggest one—then I do not think there will be any shortage of industrially oriented R&D funds in my department.

Senator Grosart: There has been no increase over the years. There may not have been a reduction in dollars, but there has been no increase, and in fact an actual reduction in your department, Mr. Minister, in support of R&D. You may take any report you like, but the federal statistics make it very clear.

You say there has not been a reduction and the fact of the matter is there has been, in terms of resources used for this purpose.

When you say that industry has not responded to these programs, surely that only means they are the wrong programs. That is not being critical because the department itself has decided that this whole approach of the 13 programs was not adequate, although it was not a complete failure.

Hon. Mr. Jamieson: Yes.

Senator Grosart: I would ask you if you are considering returning to the income tax base which was abolished, and for which these programs were substituted. Are you considering returning to that base, which is what industry has been asking for for about six years?

Hon. Mr. Jamieson: Yes, sir. I have given a good deal of thought to it. While I am not yet in a position to make firm recommendations in that regard, for what it is worth, I can give you the benefit of my views to date. There is merit in the tax system as an incentive for R&D. However, there are a number of problems as well.

The first problem is monitoring. You would have to clearly identify specific R&D activities which were entitled to a tax reduction or tax exemption.

Senator Grosart: Which you would do with every single government grant anyway.

Hon. Mr. Jamieson: It is a little harder in terms of R&D and, it certainly gets back to Senator Godfrey's point, namely, you would then be providing incentives for things which companies would undoubtedly have been doing on their own anyway. That is one of the questions.

Another aspect of the matter is that the tax reduction is only good for a company that is making money. Here is the big weakness in using it as the only tool, because what it means is that unless a company is in a position where it can take advantage, then clearly it gets no support or no help at all by way of assistance for R&D.

Another aspect of the matter which one can look at, depending upon his views of economic nationalism, is it comes down very heavily as a benefit to the multinational or the offshore owned corporation, in a great majority of

cases. Witness, for instance, the automotive companies, the whole petroleum industry—you know them as well as I do.

Therefore, it may have some application, and I do not believe it ought to be discarded without pretty thorough examination, it is not substitute for direct government help, where it is needed mostly, namely, with the smaller companies, to give them a greater degree of technological excellence and innovation, to use your word.

Senator Grosart: I would agree with that. I am not suggesting it as a panacea or anything else. I am glad to hear you are considering a return to it on a selective basis, which is the only way it can be applied.

The Chairman: To come back to what you said with reference to the study, what kind of methodology was used at that time? Was this just a review of the review which had been made by your department before, or was this something completely new?

Was there any systematic consultation with industry before that study was put in its final form and presented to you?

Hon. Mr. Jamieson: I think there was a very comprehensive study. I do not have the actual list. I do know Mr. Sharwood and others did consult with industry, and did consult with other groups and did have consultations with other departments. I would not know, however, the actual number of firms, senator.

Also, in terms of the methodology, I believe he began from a case history approach of looking at what has happened over the last X number of years in a particular program. For instance, he has very grave doubts, which I share, as to whether or not the aero space industry, in terms of that portion of it, which has been acquired by the government, whether we ought to have used these programs in support of those initiatives. I think he is probably right on that.

So, he looked at quite a wide range of criteria. My impression of the report is it is a very frank and reasonably accurate one, I think, with the normal number of biases built in which, I guess, you are bound to find.

The Chairman: There was, however, a very systematic consultation with industry?

Hon. Mr. Jamieson: Yes. By the way, I, personally, have had in the last few months quite extensive discussions with industry.

Senator Rowe: I have a question that is more of a supplementary to the point raised by Senator Carter, in relation to R&D and the potential impact of it on employment in Canada. I do not think anyone would say that we can afford to stay in the same place; in fact, we have to be like Alice, we have to run faster to stay in the same place, or to stay even with where we are now. We might be, in a sense, fooling ourselves if we think that the solution of our unemployment problems lies largely in this field of science and technology.

I am reminded of this: We have in Newfoundland, for example,—I and Mr. Jamieson are very familiar with this—two of the largest paper mills in the world. Largely, as the result of R&D, those two mills are today producing twice as much paper as they were 20 years ago, and in producing twice as much paper they are providing employment too. They are giving employment to, I would suggest, probably fewer than half the number of actual bodies they

were giving employment to 20 or 25 years ago. I am wondering if this is not something we are going to be confronted with increasingly across Canada.

Hon. Mr. Jamieson: Yes. I alluded to this earlier. My own conclusion is that we must do the R&D because the essential element in that improvement which occurred in those paper mills is, of course, competitiveness.

Senator Rowe: They would not be there; they would not be running today.

Hon. Mr. Jamieson: I do agree as well that there is no guaranteed correlation between innovation and productivity and a high level of employment. In fact, quite the contrary can occur. These are some of the things which I suspect will bedevil us in this country for the next decade or so.

I might just add, in that connection, that we have been in a good export and, indeed, to some extent, domestic position. There is nothing wrong with the R&D figures. I made the point that the pulp and paper industry has a very good record by international standards.

Agriculture, which is perhaps our biggest success story in terms of exports, grains and all the rest of it, our R&D is among the best in the world and is about double that of the United States. In other words, it seems to suggest that when the market is there and there is a good chance for grains through better competition, that the industry is very conscious of R&D and will do the necessary work, with government help, in the case of agriculture, obviously.

Senator Grosart: The essence of R&D is matching your development to your market, which is all part of the same thing. I think the argument falls down there. I mean, R&D that is not matched to the market is not R&D.

Hon. Mr. Jamieson: I am afraid you and I are not communicating very well today because that is what I thought I was saying. I do not know why my argument falls down.

I thought that is what I said.

Senator Grosart: What I am objecting to is the argument that technological development does not create employment. Overall, it is not substantiated by the literature on the subject. If you do not have the R&D, instead of having half as many people working, you will not have anyone working. So the relation is clear, in the long run, not in any particular instance. If we are saying that we have to be careful about innovation because it will not increase employment in the long run, we might as well give up the whole thing.

Hon. Mr. Jamieson: I do not again want to leave the wrong impression. You and I, senator, usually have a pretty good rapport on these matters. I said we had to go ahead with the R&D. Obviously if we do not have technological development, the whole thing falls apart. But it is what kind of technological development and how you match added productivity, which is implicit in R&D and in all of these things, to the unemployment problem.

My other point is that much of Europe—and indeed I suppose one could include Japan—is littered with misdirected R&D and innovation. We have only to look at the United Kingdom figures to see that that is a fact, of getting in too late. Take France, for instance. The amount of money spent on attempting to get a foothold in the com-

puter industry, even in the space industry, by their own admission has been non-productive, because they were too late in the field and they were trying to reinvent the wheel, in a sense. That is the only caution I am expressing.

Senator Grosart: If you say it is good, it is only good in terms of its objective. That it can be bad in spots you can apply to anything, including a marriage.

Senator Rowe: I think Mr. Jamieson may have answered my question. Going back to that figure of 100 million versus 400 million, how does that ratio stand in respect of the other industrialized countries? You may have answered it.

Hon. Mr. Jamieson: I did in a sense. There are other figures which show, I think, that there is over \$1 billion of one form or another of industrial R&D being done which affects Canada. Our percentage in industry is among the smallest of the industrialized world. As I tried to point out in my opening comments, I have sifted through a lot of this to try to figure out why that is so. There is no question but that one of the main reasons is the makeup of our industrial complex in Canada. There is so much foreign ownership, so many multinationals. I do not know what the figure is today, but about 1970, in the whole of Canada we were spending only about \$40 million a year on transportation research of all kinds. That did not mean that we were not benefiting from a tremendous investment in R&D by the automobile companies and by all forms of other transportation; but I think the main reason is that we have so many companies in Canada which are dependent for their R&D on their parent companies, wherever they may happen to be located. That leaves open the question as to whether it is a good or bad thing for Canada. At the moment I have not been asked that kind of question, so I will leave it for your discussion.

Senator Godfrey: I have just a comment on that very point. A friend of mine took over the presidency of a glass company. The first thing he did was to make a connection with an American company to get them to do all their R&D. They did not control the company. They took a 20 per cent interest, and they made an agreement. It was cheaper than doing it here.

Hon. Mr. Jamieson: If we look at the Japanese technique, it has been to some extent to buy technology in the first instance and then improve upon it . . .

Senator Grosart: Or steal it.

Hon. Mr. Jamieson: I will not comment on that observation. Eventually the Japanese get into something else. The fact is that they have gone at it from the stand point of getting the technology elsewhere and then adapting it to their own purposes.

Senator Lang: Mr. Minister, what is your opinion as to the use of the export of our nuclear technology as a potential rectifier of our trade picture, and the validity of the safeguards?

Hon. Mr. Jamieson: Those are two completely different questions. On the validity of the safeguards, I think it would be better to ask that of the Secretary of State for External Affairs, although I am satisfied that we have done better than most, indeed if not all countries, in getting safeguards.

On the question of the whole nuclear policy and the export of CANDUs, it is open to question whether or not,

at least in the short run, it will be of any significant benefit to us by way of balance of payments. Of course, a large number of these plants exported have been on the basis of Export Development Corporation financing. They have gone to underdeveloped countries with long-term financing, and things of this kind. So that while they help to some degree, I would not want to peg our hopes for a better position on balance of payments or a dramatic turnaround on our sale of CANDUs, for all the reasons I have mentioned. I am not arguing, incidentally, that we should not be doing it; and incidentally, of course, if one looks at that particular sector, which falls back on what we were talking about the sectoral strategy, it appears that depending upon what decisions are made within Canada we will need a good many of those reactors in our own country within the next 10 to 20 years to supply our own needs. So whether the export potential should be pursued is again something which I am personally looking at at the present time.

Senator Lang: You do not see any potential in hard currency areas?

Hon. Mr. Jamieson: Mostly because these countries either have their own technology, such as the United Kingdom or the United States, or they have bought it. The Swiss have opted for one of the European systems. Most of the hard currency countries that I know of we have had some success with, but it is a highly competitive field when we get into the hard currency countries.

Senator Grosart: Yet eight in the EEC who have opted for the light water reactor are anxious to have heavy water reactors. Is not the problem here that we do not have the scientific capacity to produce them, and also the capital?

Hon. Mr. Jamieson: Certainly, on the question of capital, I suppose here, once again, I am saying something that you are all well aware of, that in terms of both our capacity to manufacture and to support exports we had to exercise some degree of selectivity. I put this by way of hypothesis rather than hard cases. If we had to support a reactor with, say, \$1 billion worth of export credit financing, would we be better off with five or six \$200 million projects over a wide range of Canadian exports, if our export credits are limited, as obviously they are?

Senator Grosart: If we had the capital available, which is so in some cases, and we had firm orders, how many 300 megawatt reactors could we produce in Canada for export in a year?

Hon. Mr. Jamieson: I have no idea, in terms of the question you ask. I believe I am correct in this, but given our present competence and capability—and this would be subject to AECL's confirmation...

Senator Grosart: I know the answer.

Hon. Mr. Jamieson: I think it is a couple of years of the current CANDUs that they anticipate they could cover in terms of export orders, and that would depend largely on domestic demand.

Senator Grosart: When I was asked to find the answer, AECL told me one, and your predecessor told me six. I have often wondered what is the real answer.

Hon. Mr. Jamieson: I was talking to reality rather than to speculation. My information is that if we went on an export drive, all other things being considered, I think the feeling was that two would be the optimum number.

Senator Grosart: I agree, with our present capacity to produce, manpower, and so on.

The Chairman: Let us get back to the industrial development policy. In your brief, as Senator Grosart indicated previously, you indicate that you presented a memorandum to Cabinet early in 1975.

Hon. Mr. Jamieson: My predecessor did.

The Chairman: The brief goes on to describe the subject-matter and the general intent of those proposals. There is nothing in the brief which describes the nature and content of the proposals, except that we are told that a new interdepartmental committee on industrial policies and strategies has been created and that new industries' sectors' strategies are being developed.

Since this memorandum, which seems to be very interesting, was presented early in 1975 and has been approved by Cabinet, I wonder if we could not have a copy of it, without it being leaked.

Hon. Mr. Jamieson: In answer to your question, Mr. Chairman, I think it would be possible for us to provide you with a pretty concise or summarized version of it, enough to give you an indication of the thrust. I have talked about it today in terms of the sectoral approach, but there may be other things that may be of interest to the committee. Let me respond to you in the next few days as to how it might be done.

The Chairman: Very well. You then go on to say that you have chosen the sectoral approach, as opposed to a kind of global or macro approach. Could you indicate to us, by way of concrete cases, how these sector strategies have been developed?

Hon. Mr. Jamieson: The first step was to identify roughly 20 key sectors in the industrial community that we should be studying. We did some work interdepartmentally in terms of reference and how they should be approached. In virtually all cases now, we have invited the industry concerned, or the sector concerned, to nominate representatives to a study group, and these study groups are going forward simultaneously on a number of these different sectors. Some work has been done.

My own decision recently was to narrow that list. I found that there was probably too great a dissipation of effort and that the sectors that are in real trouble should be getting priority attention as opposed to some others, the textile industry being a case in point. That is the manner of proceeding at the present time—to identify markets, tariffs, levels of technological development, and things of that type.

The Chairman: What you are doing seems to be very close to the concept of the task forces that we suggested in our report in 1972.

Hon. Mr. Jamieson: Yes.

The Chairman: We were told at that time that it was impossible, that it could not be done. I see you have found a way to do it, and I think it is a very concrete and realistic way to proceed.

Hon. Mr. Jamieson: I certainly see no reason why it should not be done that way.

Senator Grosart: Mr. Minister, just to clarify a point, is it the intention, definitely, to replace the present multi-

plicity of support programs for industry with a single comprehensive program?

Hon. Mr. Jamieson: No, senator—at least, not if we follow the recommendations of the Sharwood Report. He recommends that some of them be “rolled in”, as he puts it; that two or three might be more comprehensively dealt with as a single program. He does recommend that others be kept with a separate identity. May I say, urging that I not be questioned too thoroughly as to why, there are international reasons for identifying them for specific purposes.

Senator Grosart: I do not want to be unfair, but the statement in the brief seems to contradict that. The brief states:

... the need was identified for a fundamental restructuring of ITC's industrial support program framework. As a result a review of the programs is now taking place, and while it would be premature to prejudge the conclusions of this review it can be stated that one objective is to replace the present multiplicity of programs, each with its own narrow objective, criteria and procedures, by a single comprehensive program.

Perhaps I did not stress the word “comprehensive.”

Hon. Mr. Jamieson: I was obviously being imprecise. Let me put it this way: there are good and valid reasons for maintaining, let us say—and I am not necessarily saying that this is one that will be retained—the defence research program as a separate identity in terms of our international...

The Chairman: It has already been integrated, I believe.

Hon. Mr. Jamieson: I suppose it is a matter of nomenclature as opposed to the objective that you list. I think there will be what will amount to a comprehensive program, but there will be certain headings and certain categories which will be left outside for reasons of international trade, tariff considerations, and things of this sort.

Senator Grosart: I think what the committee would be interested in knowing is whether it is a single comprehensive program and not a series of ad hoc programs. I am not criticizing that. We know that the 13 programs came up on an ad hoc basis in response to perceived demands, and there is nothing wrong with that, except that it did not work.

Hon. Mr. Jamieson: Not in all cases.

Senator Grosart: Overall, it did not work. That is in the past. We are concerned, largely, with the future. I would like to know that there is going to be a single, clearly stated, comprehensive program of support for industry.

Hon. Mr. Jamieson: If I could presume to invite you to give me advice in your report, or whatever form it is going to be, it would be on the following questions: How comprehensive should it be? Should it be selective? Should it have any bias in it relating to Canadian-owned as opposed to multinational corporations? Should it have a bias in favour of smaller corporations vis-à-vis bigger ones? Should it be targeted on particular segments of industry as opposed to the whole spectrum of industry?

These are some of the areas, in your deliberation subsequent to these meetings, where you could be extremely helpful, if you either recommend or even define a little more specifically what direction you feel we ought to be

going. “Comprehensive” in the sense of putting them all into one package is one thing; “comprehensive” in terms of them being available to everybody is something else again.

Senator Grosart: I think we all know what is meant by a comprehensive program. It is a program which in itself, says that it is a government program to reach the objective of adequate support for industry. That is all I mean by the term “comprehensive.”

Hon. Mr. Jamieson: If I could just add to what I said a moment ago, and in answer to that question, and making it perfectly clear that I have reached no conclusion at that point, the real question that many have been asking is whether the government can have a significant impact on research and development in the industrial sense, with the kind of financial contribution, even if it were substantially increased, that we are able to muster, and that perhaps our efforts should be more directed towards what is referred to as moral suasion, in which I do not have much confidence, or other types of policies. In other words, if the government is putting \$200 million, doubling what we are doing now, into a field where there is perhaps \$1 billion plus being spent, how much influence can it have and, indeed, is that the appropriate way to go? Should we still have these types of programs from the financial point of view?

Senator Grosart: Would not one of the major considerations be that the purpose of all these programs is to upgrade industry's capacity to absorb additional fundings? Surely that is the nub of the whole question. Every one of these programs is essentially targeted to that. We have had evidence in this committee that industry has not shown adequate capacity to absorb the kind of support for R&D and innovation that would appear to be necessary in the Canadian context. Surely, the aim of any program is to upgrade that capacity having in mind the multinational problem, the foreign ownership problem, and so forth.

Hon. Mr. Jamieson: Yes.

Senator Grosart: I think in our earlier reports we have identified that fairly clearly as one of the problems.

Senator Carter: On that point, Mr. Chairman, may I ask the minister if his department, either alone or in conjunction with MOSST, has made any survey of our R&D capacity and pinpointed our strong points and our weak points?

Hon. Mr. Jamieson: I think we can give you a pretty clear assessment of that in so far as industry, trade and commerce is concerned. I would invite either of the gentlemen on my right to confirm or argue the point, but I think it ranges from extremely good to virtually non-existent. In other words, in some fields we are exceptionally good and in others we do not have very much. Do you have any comment on that, Dr. Wagner?

Dr. Wagner: That is correct, Mr. Minister and honourable senators. There are some industrial sectors, many of them Canadian-owned, although not exclusively Canadian-owned—for example, non-ferrous metals, the paper area, some parts of instrumentation, some of the “sensor” developments, and some areas of space are now in Canadian companies and there also large areas in which, while the technological level is good, nevertheless possibly our capacity for developing the technology is not that effective. The question is whether one should abandon some of these areas and concentrate on some others or not, and that, I submit, is not an easy decision to make.

Senator Grosart: May I ask, just as an example, what happened to our great laser breakthrough which came from the Defence Research laboratory down at Valcartier? Has that been developed in Canada? It was a great Canadian innovative breakthrough.

Dr. Wagner: Yes, it was a great Canadian patent, a great Canadian technological development. Those two companies are still in existence. One of them appears to be more successful than the other. Without in any way wanting to judge what has happened, it would appear as if the commercialization coming from that is not coming as quickly as one had hoped, although in the case of one of the companies, I refer particularly to the one in the Ottawa area, it looks like it is going along better than the other. The other company, while it is still operating in the laser field, once again may have been guilty, as in so often the case with small companies, of spending a disproportionate amount of its time on the technology, and of course this is just one component of innovation. But the two companies are still in existence and still working on that laser patent.

The Chairman: Mr. Minister, I was also looking in your brief at something quite different from the reorganization of the department. I received the impression that you were trying now to integrate what you call your international trade role and the industry role. It seems to me that perhaps that is the wrong approach to the reorganization of the department, and that as you proceed along that road the industry function may be neglected or perhaps forgotten.

We had suggested in our report in 1972 and 1973 that in the Department of Industry, Trade and Commerce the sector of industrial policies should be given much more importance than it had at that time, and that new services should be added to it. We suggested, for instance, that all government laboratories which are distributed now in various departments which serve or are supposed to serve the manufacturing industries should be brought together and be made responsible to your department. We had suggested also that, without going back to creating a separate department of industry, at least there should be appointed a deputy minister of industry who would be responsible for all of these additional services. Have you given any thought to these proposals?

Hon. Mr. Jamieson: Yes. I have read and asked for a briefing on your recommendations. I must say that to date I have not reached any what I would call final conclusion on it.

On your point about integration, I think perhaps it might be useful for me to say a word about why international trade and industry, we think, and I am personally convinced, need to be very closely integrated. It is because in terms of the new markets which we have to develop it is necessary to identify in those markets—southeast Asia is perhaps a very good example of this—the kinds of opportunities for industry which industry may not be aware of and may not now within Canada have the competence to fill. Therefore, by linking our international trade development efforts back into research and development, and incidentally, into many other things, we can say, "We have been to Indonesia. This is the situation. This is what is needed."

I can use a concrete example in Southeast Asia, namely, transportation. We would have to modify anything we are doing now in order to break into what is a multi-million dollar potential in that area, and so it is to get some kind of

correlation, so that industry knows what these foreign market opportunities are, that we are moving in the direction you mentioned. I therefore do not think that it is inconsistent with what I understand to be your committee's views.

The Chairman: No. I feel that even if there were a little bit more separation between the two, people would still speak to each other within the department.

Hon. Mr. Jamieson: Well, yes, but this is only peripheral to what I see as being the basic problem. It is not, perhaps, so much a matter of your concern directly in terms of science and technology, but let us consider, for instance, the kind of packaging we are going to have to do. I was told in many countries that I visited that whereas only one bid would come in from some of the largest industrial countries of the world, because they had formed consortia in order to make the best possible presentation, a relatively small country like Canada was putting in two, three or even four bids. So there is an educational job to be done on research and development.

May I say, by way of semi-amusing comment, that Canadians also have a tendency to believe that what they have to sell is best, even though the customer says, "We don't want that; we want something else." We have found people changing tender calls because they want to upstage the fellow who had written the tender, whether he is in Indonesia or wherever he might be, and that is not very good salesmanship.

On the second part of your question, about consolidation, I am still open to persuasion, argument and discussion.

The Chairman: We are not speaking about the Fisheries Board or the research branch in the Department of Agriculture.

Hon. Mr. Jamieson: No. I think, however, that by mentioning those two you have probably illustrated one of the difficulties in this regard, and if you could address yourselves in this committee to this, it would be helpful to us; but in order for us to take the marketing function, or the research and development aimed at market, into our shop, how would we then separate out the Fisheries Research Board, which has many other responsibilities? Would we have a segment of it that would be responsible to the Department of Industry, Trade and Commerce, and the rest of it to someone else? The same is true of many of the research facilities. They are multi-purpose, and this is what I have not been able to get my own mind around. How would we do this, if we went the concentration route?

The Chairman: I would start, if I were you, for instance, by going at the simpler situations. I always refer to a very specific example, which is the Forest Products Laboratory, which is in the Department of the Environment. This is a series of laboratories, which clearly have a mission to serve the manufacturing industries.

Hon. Mr. Jamieson: But do they not have other functions as well?

The Chairman: No. Not the production laboratories, as opposed to forest research. They are completely different.

Hon. Mr. Jamieson: I see the distinction, yes.

The Chairman: And there are other labs in NRC, and we have been told repeatedly, back in 1968 and 1969, for instance, that most of these laboratories, which were sup-

posed to serve manufacturing industries, had no real usefulness vis-a-vis industry.

Hon. Mr. Jamieson: I might say that there has been some improvement since your last report. I will not say it will be entirely acceptable to you in terms of cross-fertilization—I suppose that is the appropriate term—of representatives on the two. That raises another good question, for which I do not have an answer, and that is as to whether or not, if you took the so-called marketing, or commercial, function, out of many of the research facilities, would this tend to reduce their awareness of the necessity for practical application, and the practical approach?

The Chairman: On the contrary, if they were attached to the Department of Industry, Trade and Commerce this is where we would have the coupling between marketing and research.

Hon. Mr. Jamieson: I was thinking about those elements which would then be left out. As a specific example—and I have no views on the question—I have had both points of view presented to me, one, that it is useful to have NRC with an industrial development sector within it, and the other, that that particular portion, which is about \$14 million, as I recall, should be perhaps put into something in the Department of Industry, Trade and Commerce. So there are those two points of view.

The Chairman: You are considering those points of view, are you?

Hon. Mr. Jamieson: Oh yes.

Senator Rowe: The minister mentioned something earlier which raises a question in my mind. Your department, Mr. Minister, has representation, I know, in certain countries.

What I would like to ask first is, do we have representation in all of the 150 countries in the world, or whatever the number is? Secondly, if the answer is no, what is the criterion used for deciding whether or not the Department of Industry, Trade and Commerce will have representation, for example, in Chile, or not? The third question is, what is the relationship between the trade and diplomatic representatives? I know you have representation in Australia, because a friend of mine happens to be the consul general. Is that the correct word?

Hon. Mr. Jamieson: It could be, or commercial counsellor.

Senator Rowe: His name is Kevin Osmond. He is a friend of yours, too, I believe. If there is a trade mission in any one country, is there liaison with the diplomatic representation there?

Hon. Mr. Jamieson: Yes. In terms of whether we have somebody in every country, obviously, the answer is no; but in some countries we do have many more than one. The United States is a case in point. I suppose very quickly the criterion would be where we already have a well-developed market, namely the United States, so that we can do the servicing function and be available to businessmen and to missions and to so on. Secondly, there are those areas where we see the best potential which would be areas like south-east Asia, the European Economic Community, Australia and New Zealand and various Commonwealth countries. We could get you the actual breakdown of the

figures, but my recollection is that we probably have in the neighbourhood, or slightly in excess, of 100 offices, but I would have to check that.

On the point of our responsiveness to the embassy, all Canadians overseas are indirectly responsible to the ambassador in the particular country. In that sense they work within the embassy context. But there is a very high degree of co-operation, and I may say that many of our ambassadors are now very much trade-oriented which is very helpful from our point of view.

The Chairman: You said a moment ago, and I may have misunderstood you, that you were pretty satisfied—of course there is always room for progress, but you sounded pretty optimistic today—that you were satisfied with the performance of Canadian industry more specifically in relation to technology and innovation. I am sure you are aware that for the area of higher technology manufacture in Canada our trade deficit up to about 1970 was about \$2.5 billion a year, and that in 1975 it exceeded \$8 billion. I am sure you are aware of that.

Hon. Mr. Jamieson: I am not sure where your figures came from.

The Chairman: Well, they are reliable figures. And you have already expressed some worry about this situation.

Hon. Mr. Jamieson: I think, if I am not interrupting, there is a distinction between the figure you quoted which is the total balance of payments problem...

The Chairman: Oh, no.

Hon. Mr. Jamieson: As opposed to the total trade figure?

The Chairman: No, no, I am speaking of higher technology, everything higher than primary industry and agriculture and all that sort of thing. In other words, the area of our economy which is more determined and more influenced by innovation and by the improvement of products and processes. And if this situation is going to deteriorate at that level, the other segments of our economy will not be able to reduce this \$8 billion or more deficit to a tolerable level. So that we are really reaching a crisis if we are not conscious of that situation and if we do not attempt to correct it. And I am sure, just to finish this, that we will not correct that situation if we accept the philosophy that while the technology which is coming from the United States is very good and is not expensive and all this, if it is not expensive and if it comes to us quite naturally when it has been produced in terms of innovation in the United States, that new technology will be applied only to the Canadian market, and this is no way to reduce our deficit in terms of trade.

Hon. Mr. Jamieson: Well, there are many questions and observations rolled into one there. I am not sure about the figure. I take it that you have arrived at that figure by isolating out raw materials, agricultural exports, et cetera, and taking it down to anything that is in any way a processed or manufactured item.

The Chairman: Yes.

Hon. Mr. Jamieson: Without questioning your figure at all, I would like to reserve my ability to check that. But I think, nevertheless, the validity of the observation is not in question. One of the things that I have noted in our statistics, our trade statistics and balance of payments and

so on and which creates a very big distortion, is the auto pact.

The Chairman: Which is included.

Hon. Mr. Jamieson: Which is included, and which properly should be included, because it should not have that kind of deficit. Nevertheless, when one talks about high technology and embraces the Auto Pact, it does create a distortion as to exactly where we stand. How do we resolve it in other areas? This, it seems to me, will come through a process that I believe requires identification of areas of improvement first; not totally, but what are the market prospects for us to find markets abroad, and, equally important, how can we use research and development to bring about import replacement? Obviously a dollar saved is a dollar earned in terms of the balance of payments.

Here is where I think we have to do a great deal more work on identifying where these prospects really are. For instance, I have led two missions abroad in the last six months, and I would think that by and large the lesson we learned from that was that many of the things we had gone there to sell were not things they were interested in buying at all. The benefit of the mission was in being able to ask, "If you don't want that, what do you want?" and finding out how we can apply that to our industry here to create those kinds of things. I have asked for a thorough and continuing assessment on the import replacement question, because it seems to me we ought to be able to do a lot more than we are doing in many fields.

Related to your question is the whole issue of how we are going to come out of the multinational trade negotiations now under way in Geneva, the whole tariff question and what it does to our capacity.

To broaden it even further, I suppose the issue of scale will be very important. In other words, how much research and development can we do for any sector if the only outlet for that sector is the 23 million or 24 million people in Canada? In my opinion, we must begin with a domestic base in the great majority of cases, but it has to have some extra-territorial potential, because we cannot spend a large amount of money on R&D in a lot of industrial areas simply to satisfy the Canadian market.

I am just giving you an insight into the way I think and approach these problems. As I said before, it is a very complex matter.

I should add one one final thing. I think there needs to be a good deal of education of the Canadian business community into realizing that they are living in a different kind of world from, let us say, 15 or 20 years ago, when it was simply a matter of going across the border, as I said before another audience recently, going into Buffalo and selling something in the United States, using the same currency, all very straightforward and very simple. When you get into the EEC, Southeast Asia and the Japanese markets, it means a whole new approach, and one of the big jobs of my department will be to educate or help and encourage the Canadian business community to, frankly, get up off the can and do some creative work.

At the risk of carrying on my answer too long, let me give you an example of what we have to do in this country. When I met with the Asian Development Bank in the Philippines, I found that the Japanese bid on 100 projects for every four they get. We bid on less than four out of a hundred, so you can see what kind of a success ratio we are likely to have under those circumstances. These are the

sorts of things that I believe we must do a great deal more of, as well as just the research and development.

Senator Godfrey: The evidence we had before the immigration committee was that you had to have a population of 100 million before you could really get economy of scale, and therefore it was the export market you had to look for in order to build up.

Hon. Mr. Jamieson: One of the biggest problems in Canada now is that it is probably the only highly industrialized country which is without a large domestic base or is a member of some bloc of countries, such as the EEC, the ASIAN countries, Japan and the United States. We are isolated in terms of this domestic market to which you refer.

The Chairman: Would you comment on this other remark I made, that as long as we rely on technology coming from the United States we will be largely confined to our domestic market, but it will be known technology?

Hon. Mr. Jamieson: One hears a lot about foreign ownership in Canada on a wide range of issues and, strangely enough, this is one that does not surface as much as it should. However, in my opinion it is one of the most serious of all. That is if a branch plant has been established in Canada purely and simply to serve the domestic market, then it follows that it will not get much capability in terms of research and development, or anything else. Furthermore, there is a tendency even if the Canadian branch becomes aggressive and seeks and finds overseas orders, or seeks and finds new developments, for these to be recaptured by the head office. These are things which are demonstrable and, incidentally, on the question of R&D again and government participation with multi-nationals, we must provide more safeguards to ensure that whatever is done in Canada is certainly retained in Canada and secondly, that the company has world-wide or very much larger marketing rights, at least North America, or something of that nature. We have the guidelines for corporate good behaviour, which we are monitoring and trying to make more effective all the time in terms of new applications under the Foreign Investment Review Act. Of course, a company would be highly unlikely to come in purely to serve the domestic market. We would insist that the export potential be retained for Canada. So we are seeking through those means to bring this about.

There is no question, either, that the extraterritoriality of United States law has some inhibiting influences. A case was publicized in recent days relating to a Rolls Royce-Pratt & Whitney initiative which might run counter to anti-trust laws in the United States, but which has a very big and significant impact as far as Canada is concerned. We have made overtures to the U.S. with regard to that particular project. However, these are the kinds of difficulties that are in the way of achieving the better balance to which you refer.

Senator Carter: I wish to refer to the question you raised yourself about high technology and deficit in trade, which was the point I was trying to make earlier. I can tell the minister that I think he can find these figures in his own department. However, we had figures presented to the Standing Senate Committee on External Affairs with respect to our study of trade relations with the United States, which confirm that. Despite what the minister says, I still think that that trade deficit and high technology represents an awful lot of lost jobs in Canada.

Hon. Mr. Jamieson: I do not believe I quarrelled with that as such: I simply said that it was not guaranteed.

Senator Carter: No, there must be lost jobs in that respect and we are never going to recover unless we take some steps along that line.

The minister concluded his presentation with a reference to the future and mentioned energy, space, ocean and, I think, something else. However, with respect to energy, could you tell us something about your industrial strategy or sectorial strategy for energy; what problems are you zeroing in on in the energy field?

Hon. Mr. Jamieson: Of course, there was a huge book published only last week by my colleague, the Minister of Energy, Mines and Resources, on this general issue. I, from the standpoint of the Department of Industry, Trade and Commerce, which is the perspective in which I am addressing the question, am primarily concerned in getting the maximum industrial benefits for Canada out of whatever initiatives are undertaken. In other words, the offsets problem and the business of procurement within Canada of materials that are used in the Arctic, offshore and in other regions. That is the principal responsibility of my department in that regard. The Department of Energy, Mines and Resources is the lead agency, as it were, in determining what energy policy, per se, will be.

I could answer a specific question or more, if you had them.

Senator Carter: To be specific, then, let us think in terms of windmill and eggbeater generators, which have a wide application in areas in which there is the constant wind of a certain velocity and, particularly, in isolated Arctic regions, and other countries are in the field. Is this one of the reasons you think we should keep out of it, because other countries are there?

Hon. Mr. Jamieson: I do not think Industry, Trade and Commerce should be in it, unless there was a very definite market potential for it, that is, in the export field. I think it is very much in line with what ought to be done by other agencies which have some responsibility for research, for technological development, things of that kind. It is not the sort of thing we would normally enter into.

We are back to the basic point that if a company in Canada had some thought that it could develop some low cost energy generating kind of system, be it wind or whatever, and came to us and made a logical case, then they would be eligible under our development programs. I don't know if anybody has.

The Chairman: Provided it is a company.

Hon. Mr. Jamieson: Not necessarily. Perhaps, doctor, you may want to say something on that.

Dr. Wagner: In that connection, gentlemen, there is some work being done on the matter of wind energy at the National Research Council. I would agree with the minister that at this point in time that is a question of basic research.

There are applications for these in some northern stations. They are not very cost effective as far as we can see at the present time down here. So, they are not really very close to industry at this point in time but there is a watching brief being held on that as well as other things such as solar energy.

The Chairman: Will your new bank, for instance, develop experts to look after the last innovation stage for these rather small projects?

They do not require much venture capital, but very often the seed money is tremendously important. I was sorry to see that this was not spelled out in the legislation for the bank.

Hon. Mr. Jamieson: You are speaking of the Federal Business Development Bank?

The Chairman: Yes.

Hon. Mr. Jamieson: It has a fairly broad mandate. My guess is it is adequate to deal with that situation.

If I could link this to another question to the committee—if I am not presuming too much—the FBDB has very much the same kinds of problems we are talking about, in terms of assignment of research and development funds, that is, how do you decentralize.

The FBDB is doing considerably better than it used to, in terms of the various regions of the country. There is no reason to think that if someone came up with a worthwhile, as you have described it, venture capital proposition on energy or anything else that FBDB would not look favourably upon it, or that they would not get research and development funds.

The big question, in this context, is how does the chap in Newfoundland or Saskatchewan or somewhere, who has not got the skills within his particular company to go at this in the right way, how do we make ourselves more responsive to that kind of situation, and perhaps even at a higher risk put money into something that looks promising and has some potential.

The Chairman: It is now 5.30. I think we have had a fairly full afternoon.

Senator Bell: May I ask one short question?

The Chairman: Yes.

Senator Bell: Is the Sheraton Park Science City concept a valid one, in your opinion?

Hon. Mr. Jamieson: I am not sure I know about it.

Senator Neiman: It is the Ontario research sponsored by the Ontario government, just on the outskirts of Toronto.

Senator Bell: You have private companies coming in.

Hon. Mr. Jamieson: That is a short question requiring a tremendously long answer because one subject we did not touch on today was the overlap between what provinces are tending to do in this whole field, and how much correlation there should be.

We have heard a lot today about the necessity to get departments working more closely together, but I think some of the things that are being done at the provincial level are quite good. However, as with a lot of things, our assessment is that the smaller provinces, in particular, are probably more likely to have losers than if the whole thing were correlated.

In other words, there is a tendency to support impractical kinds of things. I am not relating that as the answer, so it does not come out tomorrow that I condemn the Ontario project, because I know nothing about it.

There certainly is room, however for closer co-operation between the federal and provincial governments in this whole field.

Senator Bell: May I ask one more question? It concerns the Foreign Investment Review Board. I am thinking of a reverse situation where we have a small steel company in Canada that is doing very well. It is expanding, but it has a large percentage of American ownership. They wish to buy their way out. They would like to take over a Canadian company so that they can increase their earnings and buy their way out. They can, with research help, develop, I suppose, a structural steel component that they were getting from Australia. These things are all lumped together. This is a Canadian company with American majority shareholders. They cannot get out from under because the Foreign Investment Review Board looks at this as an American company. Here is a Canadian company which wants to buy out, but which will go down the drain because it is being mismanaged, jobs will be lost, and so on. Are you finding that you are tripping over all these great things we are setting up?

Hon. Mr. Jamieson: There are unquestionably problems. Thank God not many of them are as complicated as that one. We do have difficulties. For instance, a small Canadian company that wants to expand, that does not have the capital, and so on, which needs a linkage with a large company in the United States and therefore control is likely to be lost in the process—that is not uncommon. One of the more difficult questions is a family-owned company.

Senator Bell: Which is what this is.

Hon. Mr. Jamieson: Those cases are exceedingly difficult to decide upon. The ultimate test one has to apply is the one in the act, namely, is it of significant benefit to Canada? I have found no way yet, except in the broadest terms, to set down guidelines across the whole application of the act. I have discovered that we have to look at it almost on a case by case basis and in the process build up what one might call case law for reference in the future. But in these early stages we have to look at them one by one, and a case like that one would undoubtedly give us real trouble.

Senator Bell: We trip over our own helpful aids.

Hon. Mr. Jamieson: Often.

The Chairman: Before we leave, I understand, Mr. Minister, that we will now get the Sharwood report?

Hon. Mr. Jamieson: I would hope that I would be able to put it in your hands before the summer.

The Chairman: With or without your views?

Hon. Mr. Jamieson: Yes.

The Chairman: And an appropriate version of the Cabinet document?

Hon. Mr. Jamieson: Yes. On the former, I have to make some inquiries as to protocol. I believe I would have to table it, or something of that nature. It is my intention to do that.

The Chairman: Thank you, Mr. Minister.

The committee adjourned.



Government
Publications

FIRST SESSION—THIRTIETH PARLIAMENT
1974-76

THE SENATE OF CANADA
PROCEEDINGS OF THE
SPECIAL COMMITTEE OF THE SENATE ON
SCIENCE POLICY

The Honourable MAURICE LAMONTAGNE, P.C., *Chairman*

Issue No. 12

WEDNESDAY MAY 19, 1976

Twelfth Proceedings on:

The Study of Canadian Government and
other expenditures on scientific activities
and matters related thereto.

(Witnesses and appendices: See Minutes of Proceedings)

THE SPECIAL COMMITTEE OF THE
SENATE ON SCIENCE POLICY

The Honourable Maurice Lamontagne, P.C., *Chairman*

The Honourable Donald Cameron, *Deputy Chairman*

AND

The Honourable Senators:

Asselin	Hastings
Bélisle	Hicks
Bell	Lang
Blois	Manning
Bonnell	Neiman
Bourget	Riel
Buckwold	Robichaud
Carter	Rowe
Giguère	Stanbury
Godfrey	Thompson
Goldenberg	van Roggen
Grosart	Yuzyk
Haig	

27 Members

(Quorum 5)

Order of Reference

Extract from the First Report of the Special Committee of the Senate on Science Policy, presented on July 10, 1975 and printed as an Appendix to the Minutes of the Proceedings of the Senate of that day, and adopted by the Senate on July 24, 1975:

"The Committee, therefore, recommends that it be authorized to consider and report on Canadian government and other expenditures on scientific activities and matters related thereto;

That the Committee have power to engage the services of such counsel and clerical personnel as may be necessary for the purpose of the inquiry;

That the Committee have power to send for persons, papers and records, to sit during adjournments of the Senate and to report from time to time; and

That the Committee be authorized to print such papers and evidence from day to day as may be ordered by the Committee."

Robert Fortier,
Clerk of the Senate.

Minutes of Proceedings

Wednesday, May 19, 1976

(21)

Pursuant to adjournment and notice, the Special Committee of the Senate on Science Policy met this day at 3:40 p.m., the Chairman, the Honourable Senator Lamontagne presiding.

Present: The Honourable Senators Bourget, Cameron, Carter, Godfrey, Grosart, Haig, Hicks, Lamontagne, Lang, Neiman, Rowe and Yuzyk. (12).

In attendance: Messrs. Philip J. Pocock, Director of Research, and Jacques W. Ostiguy, Chief of Administration.

The Committee resumed consideration of its Order of Reference dated July 24, 1975 relating to the study of Canadian Government and other expenditures on scientific activities and matters related thereto.

The following witnesses from the *National Research Council of Canada* were heard:

Dr. W. G. Schneider, President;

Mr. W. A. Cumming, Vice-President,
(Laboratories);

Dr. R. D. Hiscocks, Vice-President,
(Industry);

Dr. Pierre Grenier,
Member;

Dr. Gilles Julien, Director,
Office of Grants and Scholarships.

The Chairman made an opening statement, during which it was *Agreed* to print as an appendix to the Committee Proceedings of this day, certain selected sections of the brief presented to the Committee by the National Research Council of Canada. (*The brief in question will be printed as an appendix of the proceedings at a subsequent meeting at which officials of the National Research Council of Canada appear*).

During the question period, the Committee *Agreed* to print, as an appendix to this day's proceedings, the complete list of officers and members of the National Research Council of Canada. (*See Appendix "20"*).

At 5:40 p.m., the Committee adjourned until 3:30 p.m., Wednesday, May 26, 1976.

ATTEST:

Patrick J. Savoie,
Clerk of the Committee.

The Special Committee of the Senate on Science Policy

Evidence

Ottawa, Wednesday, May 19, 1976

The Special Committee of the Senate on Science Policy met this day at 3.40 p.m. to consider Canadian government and other expenditures on scientific activities and matters relating thereto.

Senator Maurice Lamontagne (*Chairman*) in the Chair.

The Chairman: Honourable senators, today we will hear the representation of the National Research Council. I am pleased to welcome on your behalf Dr. Schneider and his colleagues. I remember that during our first inquiry, in 1968 and 1969, NRC's first brief dealt with general issues of science policy, including its general role in this area. That first presentation had to be supplemented subsequently by a more direct and detailed response to the questionnaire which had been circulated by our committee. I have to note that on this occasion NRC has followed the opposite approach and its presentation is limited to a response to our questionnaire, providing a great abundance of detailed information, but that it does not deal with important and more general areas of science policy.

While Dr. Schneider in his letter of transmittal to me mentioned that Mr. Drury had already commented on the committee's recommendations concerning NRC contained in volumes II and III of our report, I hope that the minister's rather brief observations will not prevent us today from returning to those issues and recommendations during the discussion period. The abundance of material, most of which has already been published, raises the question of printing. I do not think that we should print the exhibits as appendices to our proceedings, as they are fairly voluminous, as you can see. As to the main reply to our questionnaire, I suggest that we should reproduce only the information which is not otherwise available and that we should leave the selection of excerpts to our Director of Research, Mr. Pocock, in consultation, of course, with the appropriate officials of NRC.

Do you accept this suggestion?

Hon. Senators: Agreed.

The Chairman: Mr. Pocock will be in contact with you and your officials, Dr. Schneider, and will make a selection of excerpts.

As to the procedure we should follow today, I suggest that we should go through the brief section by section as closely as possible. In this way we will be able, I am sure, to ask all the more general questions that we may wish to raise as we go along. I propose, however, that at approximately five o'clock today we should start to discuss section 2.9 at page 149 of the main brief, dealing with projects. Honourable senators who were members of this committee in 1968 will remember that Senator Grosart had devoted at that time special attention to this very important issue. I have asked him to do the same with respect to the present

occasion so that I would expect that starting at approximately five o'clock Senator Grosart will lead the discussion with respect to this specific area. If we are not finished with it by the time we adjourn we will, of course, continue next week, when I presume you and your colleagues will be available Dr. Schneider. If this procedure is acceptable, we should now move to the brief and I am waiting for questions.

If members of the committee are not yet ready to ask questions, I might start with respect to the section on page 1 headed 2.1, "Organization" where you say that NRC reports to Parliament through a designated minister. Would you care to define more precisely the role of that minister? Is he, for instance, a mere spokesman or intermediary for NRC in its relationship to Parliament, or does he actually participate in managerial and policy decisions of the council? There is always some confusion with respect to Crown corporations, as you very well know.

Dr. W. G. Schneider, President, National Research Council of Canada: Yes, Mr. Chairman; first of all, the title of "designated minister" is one that I think has been adopted and is now used in the NRC Act.

The Chairman: Yes.

Dr. Schneider: This means effectively designated by the Prime Minister. As far as his function is concerned, I suspect to some extent this depends on the style of particular ministers. In this case I can only refer to Mr. Drury's style. That is, as you have mentioned, that he reports for NRC to Parliament. He is the minister to whom NRC reports, but he will also tell you, as he has told me, that as designated minister he is not responsible for NRC as there is an advisory council appointed by Order in Council and in effect the legislation, or at least this is the way it is interpreted by Mr. Drury, provides for an outside advisory body to assume many of the functions which normally would be carried out in a different manner for, let us say, a department or another structure. In other words, the outside advisory council is intended to advise on the operations, the functions of the council, review and supervise its work and, of course, there are many other built-in supervisory evaluation and monitoring activities by central agencies, such as Treasury Board, MOSST and others. However, the role of the minister is primarily that of the minister to whom the National Research Council reports and to whom we go when we have problems. There are, of course, also certain legal statutory requirements, such as the signing authority, approval of appointments, capital budgets and so on.

The Chairman: So that the relationship between NRC and the minister is more or less like the relationship between the CBC and the minister—not responsible, but the minister designated to be the spokesman for the CBC in Parliament?

Dr. Schneider: There is a difference, I believe; CBC comes under another schedule. There are, I believe, four schedules for Crown corporations. The NRC is a departmental corporation, schedule B, under the authority of the Financial Administration Act. In other words, as far as financing and budgetary matters are concerned we are no different from a department. However, other Crown corporations, which are closer to a commercial operation, would come under another schedule, so there is this distinction.

Senator Hicks: Mr. Chairman, I am not sure from what Dr. Schneider said that I followed him correctly. When you refer to the outside advisory council, to which the minister referred, do you mean the National Research Council and its 17 members in addition?

Dr. Schneider: That is right.

Senator Hicks: That is the council itself?

Dr. Schneider: Yes.

Senator Hicks: So you were referring, then, to the National Research Council?

Dr. Schneider: Yes; they are the body charged with the responsibility of advising on the work of the council and its structure and organization and of giving guidance to the various programs it undertakes, and of monitoring, evaluating and reviewing its work.

Senator Godfrey: Do I understand that the Council has no direct power, the National Research Council members of 17?

Dr. Schneider: Oh, yes, they do in fact under the act. Precisely. They supervise the programs of the National Research Council and these are under their general direction.

Senator Godfrey: I was on Canada Council. I often felt like an outsider, but I never officially referred to it.

Dr. Schneider: The Canada Council is somewhat different.

The Chairman: The Canada Council is not even an agency of the Crown.

Senator Grosart: Well, you set it up.

Senator Bourget: Would it be possible to have a list of the members of the Council?

Dr. Schneider: Of our Council? Yes. We would be happy to provide that together with their affiliations. I apologize for not having that with me, Mr. Chairman. We have such a list in our annual report, but I failed to bring a copy with me today.

Senator Bourget: Are most of them replaced or retired after three years, normally?

Dr. Schneider: The normal term is three years, but there is a possibility of reappointment for another three years. In the normal course some will be reappointed for an additional three years.

Senator Hicks: A goodly number are in fact reappointed.

Dr. Schneider: Yes, probably half or less than half. It is something of that order.

Senator Hicks: Perhaps the personnel of the Council might be listed in the minutes of this meeting for easy reference.

The Chairman: All right.

Dr. Schneider: We will be happy to provide that information, Mr. Chairman.

The Chairman: Again on this section I would like to try to relate your research activities to your organizational chart which appears on page 3. You say that your labs have now been divided into three main groups, which appear on that chart. Would it be true to say that your basic and exploratory research and your long-term research are concentrated in your physical, chemical and biological science labs, and that your industrially-oriented research and development activities are concentrated in your engineering labs?

Dr. Schneider: That is perhaps too strong a description.

The Chairman: It is just a question of emphasis, really.

Dr. Schneider: To some extent. First of all, this organization chart has become obsolete in that we have just made a new appointment. You may know that one of our vice-presidents, Dr. John Keys who, just looking at this organization chart, was vice-president for program development and also had responsibility for a number of activities shown here, has recently been named Assistant Deputy Minister in the Department of Energy, Mines and Resources. As a result we have now made a slight reorganization and some reallocation of duties of the existing vice-presidents. A new vice-president has been named who will take up his duties on June 15. He will now be called Vice-president Responsible for Personnel and Administrative Services, including such things as collective bargaining. Consequently, we have made some reallocations of duties.

The Chairman: But he will have nothing to do with the labs.

Dr. Schneider: He will have nothing to do with the labs. One of the purposes here is to lighten the load of one of our vice-presidents, namely Bill Cumming, who had been responsible not only for laboratory operations but also for a lot of other things. He will now concentrate on the scientific programs of the laboratories.

When you talk about division of laboratories into three groups, the division shown here is really for the convenience of the management committee. There is no formal division, nor have we created another layer of administrators here. Rather, these group directors are chosen to act as members of the management committee for a period of years, probably three years, and in that capacity they represent the particular grouping of laboratories in the deliberations of the management committee. They work closely with the other directors in their particular group. Outside of that there is no formal division.

These are all different sets of laboratories and with respect to their role and function it is true that the group in the biological sciences and in the physical and chemical sciences do a greater proportion of long-term research and perhaps somewhat less development and applied research; although they all do quite a large amount. On the other side, the engineering laboratories are putting a greater emphasis on applied research, and to some extent development where they work with industry, as well as a certain

amount of basic research. This is what you would expect, I think.

The Chairman: Yes. Empirical studies have shown that scientists and engineers very often respond to quite different motivations and apply different methodologies and require different types of management and working conditions. Do you use different administrative principles and procedures for your science laboratories, where your curiosity-oriented and long-term development research is, let us say, concentrated, and different methods for your engineering labs?

Dr. Schneider: To answer that in a general way is a bit difficult. The easiest distinction is between those projects which, let us say, are closer to the applied area. When we have defined such a project which we have either been asked to undertake or which has ended up as a joint undertaking, perhaps with some outside laboratories or other departments, we put together a project team and there would be a project leader. This is handled in that way.

On the other hand, for example, a physicist doing fairly basic work on long-term research may have a group working with him. The ideas for that research are largely generated internally, and providing ideas are followed up. In that sense there is a difference in how you go about it.

Accordingly with respect to the management responsibility of the director, if you compare the different laboratory units, it becomes a question of what sort of mix you have between project research on the one hand and program research on the other.

The Chairman: I remember that in 1972 Dr. Solandt in his last report as Chairman of the Science Council suggested that pure research groups in NRC be organized into an institute for pure research which would report to NRC's president and Council, but which would be administratively separate from the applied laboratories. What do you think of that proposal?

Dr. Schneider: First of all, in today's climate, at least within government, a laboratory set up entirely for the purpose of doing basic research would have a difficult time surviving in the long term. The pressures on it to be doing other things other than basic research, for one thing, would be very great. I think that is a minor point. I think really it would then have to be evaluated on performance.

In our view, a more important consideration is the interrelationship between those people in the laboratory doing fairly long-term or basic research, or attempting to be on the forefront of a particular area of science, and the kind of feedback and interaction that they can provide to other people in the laboratory. They become an expert in a particular area, where they are up on all the latest advances in their field. They can be of tremendous value in helping other people working in related areas, but perhaps with a more applied objective.

I think this kind of feedback interaction, synergism is essential. I think if you have people in a laboratory doing only applied work, very soon they will get behind with what is happening in the forefront of the field, because they are preoccupied with the particular objective they have, and some application they want to get in place as soon as possible; and without the contact of people being in the forefront, they may miss very important opportunities, and I think eventually the standard of the science they do would become more mediocre.

The Chairman: Do you not think that even if they were separated, administratively speaking, they could still talk to each other and they could move from the institute to the other labs, or to other government labs or other places?

Dr. Schneider: In a sense this does happen. It is a question of degree. For example, we have, as has been mentioned in this report, fairly recently put together all our activities in astronomy-astrophysics into what we have called the Herzberg Institute of Astrophysics, in honour of Dr. Herzberg, our Nobel laureate. This has brought together in one unit—not necessarily under one roof, because some groups are in other parts of the country—at least an identification in the one organizational unit; and, of course, there is still the possibility of interaction and communication with the other laboratory groupings.

I think that when this is convenient to do so, you do it. I do not think there are many sort of rigid guidelines or optimum organizations. I think that organizations are a means to an end. In the end it is the people that count. You can have a good organization, but if the people do not want to make it work, it won't work. Or you can have a bad organization, but if they are good people and they want to work together, it will work perfectly.

The Chairman: I think you need both: good people and good organizations.

Dr. Schneider: That is so.

The Chairman: Apparently this grouping on the chart does not have too much meaning. I was going to ask if you had a distribution of expenditures between these three groups of laboratories.

Dr. Schneider: With the laboratories?

The Chairman: Yes.

Dr. Schneider: I thought you meant under the responsibilities of the vice presidents. I could not give it to you for the laboratories at this moment, but we can dig it up for you. I would like to correct an implied misunderstanding about our most recent re-organization. The chances which have been made are not that radical. The laboratory groupings remain as they are. The management committee remains as it is. Some of the duties of the vice presidents have been reallocated. But basically, in budgetary allocations, we have a number of votes, as you know, attached to these programs, and in each case the particular votes would be assigned under the responsibility of a particular vice president.

The Chairman: We have received a number of criticisms from biologists in the universities to the effect that there is not enough money available for biologists in universities and that perhaps there was too much intramural activities in your labs in the biological field. That is why I was asking the question, in order to have this kind of breakdown of your expenditures between these three groups of labs. It would be useful to us.

Dr. Schneider: We could do that. On this point . . .

The Chairman: I intend to come back to that later. I am sure other members of the committee will want to touch on that also. I do not want to raise that issue now. I just wanted to know if we could get the figures.

Senator Grosart: Has anyone *not* complained that they were not getting enough money from NRC?

The Chairman: I think there was a special lobby, so far as biologists are concerned, as far as I know from the number of letters I have received from various biologists in universities across the country.

Dr. Schneider: Are you sure they were referring to biology in NRC, because there was a study done a number of years ago and more recently which has now been published by the Science Council. They strongly urged that the biology research being done at NRC should be maintained and expanded. The committee which put this report together were largely academics.

The Chairman: Very often the academics do not agree. I can show you quite a number of letters complaining about this. I want to raise that at a later stage when we come to your granting function.

Senator Carter: Dr. Schneider referred earlier about following up promising ideas. Before we get too far from the subject, I wonder if he would tell the committee of any current projects going on, sponsored by the NRC, which he finds to be of an exciting nature and of great promise to Canada?

The Chairman: Senator Carter, I am sorry, but I do not think you were here at the beginning. I said at the beginning that we would discuss this particular issue, which is very important, when we came to page 149, where there is a list of projects. We will come to that about 5 o'clock. I have asked Senator Grosart to lead a discussion on this, and you will have the opportunity to raise questions at that time.

Senator Carter: If I remember correctly, when NRC was before us on the last occasion, they stressed the importance of long-term R&D compared with response to short-term problems. Can he tell the committee what fields of science and technology they are concentrating on at the present time?

The Chairman: It seems to me that that is a supplementary to your first question.

Senator Carter: No, because you were talking about expenditures...

The Chairman: I am sure you will have the opportunity later. Let us try to be as systematic as possible and deal with the sections. You will have plenty of opportunity to raise that question later. Are there any further questions directly related to the first section? I would propose that discussion of the section appearing on page 9 dealing with formal agreements with foreign organizations be delayed until we reach page 23, section 2C, subsection 4, which deals also with international relations. Is that agreeable?

Hon. Senators: Agreed.

The Chairman: According to the brief, I see that we are at page 12. This section deals with your major programs. Program A, for the most part, deals with your internal programs or intramural activities. Are there any questions on that part of the brief?

Senator Carter: Mr. Chairman, I am a bit lost as to what type of questions you wish.

The Chairman: I think general questions about the orientation of the activities, but not questions on specific projects.

Senator Carter: To my mind, that would be a waste of time. We can talk in generalities all afternoon, but unless we get down to specifics it is not going to mean very much.

The Chairman: Well, let's talk about generalities until 5 o'clock. As I said at the beginning, we will be specific after 5 o'clock. I have some questions to ask which are fairly general.

Your minister, Mr. Drury, when he appeared before the committee, stated that the government intended, and I quote: "—to encourage the agency to make a significant internal shift in emphasis towards support of Canadian industry." The agency he spoke of, of course, is the NRC. Have you received any encouragement from the government to move in that direction; and, if so, to what extent have you responded to that encouragement?

Dr. Schneider: First of all, let me say that when we talk about "a significant shift towards industry", we do not necessarily mean more in-house programs. We mean a concentration on activities, research projects, and so forth, preferably where industry either participates or carries it out within industry. We have very definitely moved in this direction. Certainly, one of our priorities, and one of the priorities of the government, at the present time, is to help build up industry's capability, both towards innovation and in remaining competitive in existing activities.

As far as the laboratory programs are concerned, these are largely intended to be complementary to the work of industry, and not to undertake work in our laboratories that we feel could best be done in industry, such as product development or process development. If there is some long-term promising idea of the kind that industry is not likely to undertake, then we would consider undertaking such a project in our laboratories.

As an example, we are looking at the present time at the possibility of a national program on thermal fusion, which would be advanced technology. No final decision has yet been made on that project, but you may have heard about it. It is probably a long way down the road. At the present time, however, industry would not feel that it could allocate funds for such a project because of the risk involved. One simply doesn't know when it might pay off.

That is one example of a project involving advanced technology that might be done in-house. Other in-house programs might be shorter term and perhaps more related to providing unique facilities that industry needs to test some of its models or designs, such as we have in hydraulics, ships lab, in the wind tunnels or, on the aircraft side, a low temperature facility where industry can test model performance under extreme conditions, and so forth. These are facilities that are made available to industry. We are, of course, paid by industry for the use of these facilities. This is another type of assistance.

The Chairman: But this is not a new activity. This is a continuing activity.

Dr. Schneider: It is ongoing, but it does demonstrate the way we work with industry and complement industry, but not try to compete with it. We are very careful to avoid trying to compete with industry. If one of our scientists, as a result of his work in research, feels that there can be a very important application for something, he will take it far enough to see whether or not it is feasible, and perhaps as far as a lab demonstration, but at that point we insist that the next stage of development, the development of the

prototype or a pilot plant, or this type of thing, be contracted out to industry. We would not pursue that in our laboratory.

Senator Grosart: What page are we on, Mr. Chairman?

The Chairman: Page 12.

Senator Grosart: You cautioned Senator Carter earlier, Mr. Chairman, I am afraid Dr. Schneider is now doing what you would not allow Senator Carter to do, in that he is going all through the brief dealing with sections relating to industry, and everything else. Is it the intention to go through the brief section by section or not?

The Chairman: I think my question was relevant to that section. It was a general question. I understand now from the answer that the significant shift to which the minister referred has nothing to do with the intramural activities of the council; rather, he was expressing the hope that there would be more grants and contracts given to industry through the council's program of assistance.

Senator Hicks: This includes grants?

Dr. Schneider: The IRAP program does involve grants, but it is cost-sharing. We pay something in the order of 50 per cent, or less. These are in the form of grants as opposed to contracts, or agreements, if you like.

The Chairman: Senator Carter, I believe, had a question.

Senator Carter: I should like to get clarification of what Dr. Schneider was saying, Mr. Chairman. As I understood his statement, if a project got to the stage of developing a prototype, that work would be contracted out to industry.

I am wondering whether the reverse is true. In other words, if industry, in the development of a project, comes across a problem with which it cannot cope, would the NRC then take over and try to resolve that problem?

Dr. Schneider: Yes, we would respond. We would not do the total development, of course, in terms of carrying on with the project, but we would certainly assist industry in overcoming any problem. The industry concerned would probably work very closely with us towards the solution, and once the problem is solved, industry would continue to develop the project on its own.

Senator Bourget: How closely do you work with industry? How do you know the needs of industry? Are you aware of industry's needs through industry's members on your council, or do you have some means by which you can determine industry's needs?

Dr. Schneider: Both, senator. There are many contacts and many mechanisms. I do not know whether you wish me to elaborate on all of them.

The Chairman: There is a later section in the brief which deals with that aspect of it. Perhaps you can reply briefly at this stage.

Dr. Schneider: Briefly, there are several levels of contact. About half on our council members come from industry, representing different sectors of industry and different parts of the country. They bring a certain contribution to this particular area. In addition, we have quite a number of associate committees, advisory committees and special ad hoc committees, particularly in areas where problems have been identified, through which we work with indus-

try, and then, of course, there are contacts through individuals. Industries come to us seeking our help. We also have, through the Technical Information Service, a number of industrial field engineers who go around visiting companies, mainly smaller companies, to help them with their problems or to bring their problems to our labs for solution.

The Chairman: Senator Carter had a question a moment ago with respect to the importance of NRC to basic research. You may ask that question at this point, if you wish, Senator Carter.

Senator Carter: I do not quite know what the question was now. In any event, I believe it commenced by referring to the long-range R&D as opposed to just brush-fires or meeting temporary problems. I believe my question was: In what fields is NRC now concentrating their long-term R&D?

Dr. Schneider: The highest priority area at the moment in long-term R&D is in connection to what we have termed research related to long-term problems of national concern, such as energy, food research, building, construction and transportation. However, these have very specific objectives and are also being developed into integrated programs at the federal level. That connected with energy is already in place; the others are in process. There may be others, such as ocean technology. There are long-term as well as some short-term problems involved, which we feel need a good deal more emphasis. This is certainly one area to which NRC is presently giving priority.

In terms of other research . . .

Senator Carter: Basic research?

Dr. Schneider: Basic research and long-term, I mentioned astrophysics and astronomy. This is an area which has become very exciting; there are many new developments and ways of approaching this through, for example, space telescopes. It is an area in which we will see many advances and is one for which NRC has the mandate, and to which we see some priority being given.

The other major one is molecular biology, in which a number of advances now are possible. This is becoming a very promising field and in some areas we are already getting some very good payoffs.

These are just two examples.

The Chairman: I have a question referring to the top of page 13. You mention later on in your brief and in your annual report that you devote approximately 25 per cent to 30 per cent of your activities to basic and exploratory research. Would you have similar figures for the other types of research, which are described at page 13, for long-term?

Dr. Schneider: Basic and exploratory research is at present 26 per cent. These are operational costs. The research on long-term problems of national concern at present is 23 per cent. As I mentioned, this is one that has high priority and we can expect to see it grow. Research in direct support of industrial innovation and development is 17 per cent. However, let me emphasize that this is just the in-house part; a good deal of it is extra-mural.

Senator Hicks: This does not include the grants and contracts which might be made with individual enterprises and businesses?

Dr. Schneider: Research to provide technological support of social objectives, 13 per cent; national facilities, which includes wind tunnels, radio telescopes and so on, 12 per cent; and finally, research and services related to standards, nine per cent.

Senator Grosart: Does this account for your entire budget?

The Chairman: No; it is only intra-mural.

Dr. Schneider: These are only operational expenditures.

Senator Grosart: To what percentage of your total budget do these percentages relate?

Dr. Schneider: The total budget for 1975-76 for the laboratory operations is \$63.4 million; for 1976-77, the new estimates—I do not know if you wish that, but it is \$76.47 million.

Senator Grosart: What percentage is comprised by the percentage figures that you gave us, because there is nothing here to say to what it refers?

Dr. Schneider: I am sorry; these were total dollars; not percentages. If you would like to have the percentage breakdown, I can give that to you. Are you asking for the total?

Senator Grosart: The figures of 26, 23 and 17 were percentages?

Dr. Schneider: Yes.

Senator Grosart: I am asking what percentage of your total budget is accounted for by those percentage figures.

Senator Hicks: In other words, those figures add up to 100.

The Chairman: They must be related to your total intra-mural activities, of which the total is \$74 million; this is on page 37.

Dr. Schneider: The total, including capital and intra-mural, is \$107.9 million; the percentages I gave you for operations total 64 per cent. So if we say 65 per cent or 66 per cent we would not be far off.

Senator Neiman: Mr. Chairman, my question I believe relates to page 14, the "Program B" heading, but perhaps another member of the committee has further questions on this section.

Senators Hicks: I would like to try Dr. Schneider on a more general observation; I would like to provoke him into a reply. I am looking at paragraph 3 on page 13, that which begins "Research in Direct Support of Industrial Innovation and Development". We all know that the level of industrial research in Canada is relatively poor compared with other developed countries, and so on. I do not propose to discuss the reasons for it; our branch plant economy and other such aspects are often mentioned. I suggest that the shift to which you referred in NRC's emphasis in helping in industrial research and innovation and development and so on really cannot have a very significant influence on industrial research in Canada. This may very well be a misplaced attempt on the part of government to influence the quantity and quality of industrial research in Canada.

Dr. Schneider: First of all, if you address yourself only to research, and we do not do anything else, then I would say you are right and we will not succeed. I think to

develop and stimulate successful viable industry there has to be much more than just research. They cannot live on research. If they do not have markets, if they do not have a domestic market, if they are not able to compete with imports and that kind of thing, no matter how much research they do it is not likely to help them. Research is only one of the ingredients and it complements and has to complement the other things necessary to make a viable industry.

Put it the other way: Once you have an industry which has found a specialized area in which they have some technology ahead of anything on the market at the present time—and we have a number of these which we have fostered and assisted, admittedly smaller companies which have found their special niche which they are exploiting—once such an industry has a head start, then in order to keep its markets and to be able to expand them, it has to keep finding new technologies in the next generation of products. Otherwise there comes a day when it is overtaken. So it is very important.

Now, we have, both through the Industrial Research Assistance Program and through some of the laboratory research, been able to support a lot of these good small companies.

Another program which we may get into later, which I would very much like to talk about, we call PILP, Pilot Industry Laboratory Program. I think we have the opportunity to assist these smaller innovating companies to develop specialized areas where they have advanced technology and can get access to foreign markets, their domestic market being rather small. If we can develop enough of these companies and stay with it—it will take time; we cannot do this overnight—they will grow. Some will fail, but the ones that grow will diversify. I believe we can build an industrial base in this way.

Senator Hicks: So you honestly believe my introductory statement was too pessimistic?

Dr. Schneider: And too sweeping. We have to see these things in perspective, but the most important thing is to make sure we are on the right road and, if we know we are on the right road, to stay with it; because, it takes a long time to achieve these things.

Senator Grosart: Mr. Chairman, the difficulty here is that casual references are being made to subjects in the introduction which are then dealt with in whole sections later. For example, the program Dr. Schneider just referred to, PILP, the Pilot Industry Laboratory Program, does not come until page 49. There is another section around page 20 that deals with the whole question of relations with industry. It is a question of whether we pick them out and discuss them now or wait until we get to the sections.

The Chairman: There is a lot of repetition, and that is why I am trying to at this stage get to the more general questions. Up to now we have discussed the apportionment of the budget between different groups of activities. We have not been discussing specific programs or projects. The difficulty is that there is repetition, and there are many intimately related matters dealt with in different sections. So I am afraid we will have to endure this for another half hour or so.

Senator Grosart: All right; go ahead; it doesn't matter.

The Chairman: My last question deals with the kind of redefined role of NRC you have described in your annual

report and which is more or less reproduced in your brief. When Mr. Drury was before us I compared this redefined role with the description of NRC's role given by Dr. Steacie in 1958. I found that the two descriptions were remarkably similar. I wondered if this redefined role in 1974 and 1975 is not a re-edition of the role already described almost 20 years ago.

Dr. Schneider: I do not know what you mean by "role".

The Chairman: The description you have given.

Dr. Schneider: We are a national research agency. In other words, research is our business. That is, if you like, a role. How you do this and what means you use to do it we can discuss, but how many ways are there to define a research agency at the national level which will have specific objectives which have been set out in our act? We are not suddenly going to become the post office or something else.

The Chairman: But you entitled that section in your report as a "redefined role." I am not questioning what you are doing, but you have entitled the section of your report a redefined role, and I find that that role is similar to the one described in 1958. I wonder if your qualification here, "redefined," was too strong, because it seems to me that this is the same role.

Dr. Schneider: There were two main reasons, of course. I do not know whether you missed part of the preamble to the actual activities that were laid out, but as you know the government decided and announced in early 1974 that it was going to set up a separate council and separate from NRC the functions of the program of university grants and scholarships. That necessarily means a redefinition of NRC's role. That was one of the factors. The others that are pointed out there are certainly a change of emphasis and, to some extent, a change of approach. I have already mentioned two of the areas in which the main changes of emphasis are occurring, and these are the main changes in the role that we foresee. This is why we have called it a redefined role and not a new role.

The Chairman: Are there any other questions on this section? If not, we will move to page 14. Again let us try to restrict ourselves to the more general questions.

Senator Neiman: Mr. Chairman, I noticed an article in one of our Toronto newspapers in the last day or so, which I am sure Dr. Schneider knows about, referring to research grants which were made by NRC. Without trying to recall the article exactly, I think the examples involved had to do with a number of scholarships or research grants given, a great number of which were for overseas or for research grants for people to go outside the country. There were no assurances given, in fact not even required by NRC, that the grantees of these scholarships would return to Canada once their terms had expired. I am not suggesting that I disapprove of this, but I would like to hear some comments from Dr. Schneider on the policy.

Dr. Schneider: These are not so much grants but really scholarships and fellowships to permit young graduate students to continue their program of studies, or also at the post-doctorate level, to broaden their career and gain additional research experience abroad in very specialized areas. First, I should say that the numbers are very small in comparison with the total. For the predoctoral students, in order to be permitted to hold this studentship award abroad, they have to make a case why it is necessary for

them to go abroad. There are now very few areas where this is necessary, because our graduate schools in Canada are now fairly well developed. So there are only a few exotic areas where a student could not get comparable training in Canada. But nevertheless this is permissive if the student has a good case.

Senator Hicks: Must it be Canadian?

Dr. Schneider: Canadian or landed immigrant. At the post-doctorate level we are a bit freer, because the man who has taken a doctorate has done all his study in Canada. Certainly for the very good students it is very enriching to be able to go to a good laboratory abroad and spend some time there. I think it is an accepted thing. It is done by all countries. We are the recipients of many of these people to our country. I do not know whether their country insists that they come back, because I know that a lot of them stay in Canada. I should say, from our experience of Canadians who have gone abroad to study at that level, that I do not know whether there are any who do not come back. If there are, they must be very few.

Senator Cameron: On the matter of Indian students, what percentage of them would return to their homeland? My impression might be wrong, but it is that most of them stay here in one way and another instead of going back to help their own country, which needs that help badly.

Dr. Schneider: This has been a concern of ours. It is true, and there are large numbers that want to come in. This was a bigger problem. I think it is now somewhat ameliorated by the change in the immigration laws, or at least it is now possible for them to come in under student visas, which would oblige them to go back to their country if they wanted to come in as landed immigrants. But in any case, it is still relatively easy for someone who has a bachelor degree under the points system to come in as a landed immigrant and then pursue work at a university and stay. In other words, come in, in the first instance, as a landed immigrant through the usual channels.

Senator Godfrey: On that point, when I was first on the Canada Council I discovered that 30 per cent of the doctoral fellowships were given to landed immigrants. At that time you could get landed immigrant status very quickly. These were people who were quite often enticed over the border by professors who wanted bright people and said "Well, you will get a cheap education here, and I could get you a doctoral fellowship within a week of you landing in the country." The Canada Council did—it took about two and a half years. I used to bring it up about every third meeting—decide that they would require landed immigrant status for at least one year to ensure that the person who came over had some intention of staying here. What is your experience? Do you require any length of time here for landed immigrant status?

Dr. Schneider: Yes.

Dr. Gilles Julien, Director, Office of Grants and Scholarships, National Research Council of Canada: We ask them to be here for one year before they can get a fellowship.

Senator Hicks: Here under landed immigrant status for one year?

Dr. Julien: Yes.

Senator Rowe: Senator Godfrey said that 30 per cent of the doctoral fellowships go to non-Canadians. By whom?

Senator Godfrey: By the Canada Council. Of the \$10 million a year that the Canada Council spent on doctoral fellowships, \$3 million were going to people at that time who were landed immigrants. Most came over to take advantage of the program. There was no evidence that they were genuinely landed immigrants.

Senator Rowe: How does that jibe with the percentage in the case of NRC?

Dr. Schneider: Certainly if they have earned their doctorate degree at a Canadian university, they may have come in as landed immigrants some years before that, but they will certainly be eligible, along with Canadian-born candidates, for the certain number that are awarded for study abroad.

The Chairman: Are there any further questions on this subject?

Senator Cameron: What percentage of Indian students actually go back? I have a feeling that a number come here and stay here.

Dr. Schneider: If they now come in with student visas, they are obliged to go back.

Senator Hicks: But this has only applied in the last year and a half.

Dr. Schneider: Yes. There was a problem before. Also, if they can come in as landed immigrants in the first instance, through the normal channels, and then come to a Canadian university, they would be eligible after one year for all the grants and scholarships. But once they have been given landed immigrant status, they are treated as Canadian citizens.

Senator Hicks: That is right, and Statistics Canada classifies them as Canadians in its tabulations.

Senator Carter: Are we still on page 13, paragraph two?

The Chairman: We are on page 14, Program B. Are there any further questions? I am now at page 16, Program C. Do you find that this general service of information is really useful to the users. Very often these information systems are useful for the scientific community at large, but not so much for the users of the results of the research.

Dr. Schneider: That is a question to which we have addressed ourselves. It is true that the scientific community is fairly well served, particularly in universities; but we are particularly concerned with the smaller industries, industries generally, the public, and so on; and to determine what the potential market of clients are, we have started a pilot program before we attempt to develop this nationwide network of scientific and technical information. It is to evaluate precisely this question: what kind of information do these people need, what form do they want the information in, what kind of service do they want, how quickly do they want it, and those kinds of questions. That is the purpose of the pilot referral centre which has been established outside of Toronto, before we go much further with the planning.

There is also the question ultimately of what kind of information, or, if they are provided these services, are they prepared to pay for them, because hopefully once the network is established and we are providing the services, hopefully the operating costs can be recovered. It comes

down to what value you attach to it to see whether it could be a viable system across the country.

The Chairman: Pages 17 and 18 comprise more or less a repetition of pages 12 and 13, going back to your activities.

Moving to page 19, "Functions and Responsibilities." The first one is "Relations with Other Federal Agencies." Referring to your chart on page 5, it seems to me that you are doing a good deal of intramural research on matters which are closely related to the field of agriculture, such as animal and cell physiology, plant cell and bacteria culture, and so forth. There are quite a number of other areas set out on that chart. How do you arrange your programming in relation to the Research Branch of the Department of Agriculture?

Dr. Schneider: We have very close cooperation with the Department of Agriculture. Certainly, before any new program is implemented, it is always discussed with the Research Branch of the Department of Agriculture. The National Research Council usually takes responsibility for the longer term research. The Department of Agriculture feels that it simply cannot undertake such programs because of the pressure on it for the shorter term programs. I could give you a number of examples at the Prairie Regional Laboratory where we have worked very closely with the Department of Agriculture. We have had some very successful programs. The rapeseed program is a good example. Another one is the field peas, the legume seeds that are now under development. The NRC laboratory, which has specialized in plant science, does more of the longer term, fundamental plant chemistry aspect of it, whereas the Research Branch of the Department of Agriculture would concentrate on the shorter term plot tests, and some of the genetic breeding tests, and so forth.

The Chairman: How are your relations with the Department of Agriculture structured? Do you have a joint committee, or is this done on a personal basis, a scientist-to-scientist basis?

Dr. Schneider: There are various mechanisms of contact at every level. I mentioned earlier that the food R & D program, which we hope will be a federal-integrated program, is currently being discussed with the Department of Agriculture and other departments. There is also a coupling of a number of the committees that we have for university grants. There are obviously a number of university projects that are of interest both to the NRC and the Department of Agriculture, and scientists from the Department of Agriculture serve as members of committees that evaluate these projects and monitor them. There are also contacts at the working level on a scientist-to-scientist basis between the NRC and the Department of Agriculture. The Department of Agriculture has several advisory committees, CASCC being one of them, and there is also overlapping between some of our people and the department's council. There are many interdepartmental committees, such as that on pesticides, on which we have representation. The Department of Agriculture is represented on the advisory board for the Prairie Regional Laboratory.

Senator Cameron: Isn't it also true that you have units on university campuses?

Dr. Schneider: Yes.

Senator Cameron: On all university campuses, or just some?

Dr. Schneider: Just some. Of course, the Department of Agriculture also has such units. In Saskatoon, for example, there is both a Canada Department of Agriculture laboratory and our Prairie Regional Laboratory. Both labs are quite close and collaborate on many projects, and also with university departments.

Senator Neiman: Is there any mechanism whereby you can ensure that a proposed program has not already been undertaken by some other body?

Dr. Schneider: Very much so, senator. We always make sure that there is no duplication. It can happen that one may escape, but we know whom to consult when a particular program is proposed.

I might add, the scientist who is going to undertake a program is not going to undertake a program which he knows someone else is working on. First of all, he does not want to duplicate and, secondly, he wants to be first with something. There is almost a kind of natural selection. This can also go too far in the sense that everything becomes too fragmented. We sometimes have to draw these people together and try to get a synthesis in a type of program where several aspects of the same problem would be subject to investigation and coordination.

The Chairman: Are there further questions on relations with industry?

Senator Grosart: Yes, Mr. Chairman. Let me first say that this is the most strangely organized presentation I have ever seen in my life. To follow a subject such as this, you start at pages 20 and 21 and there is a direct reference to something that you find on page 59, which is vital, and then you jump to page 201 to find a list of the programs. You then have to go to page 64 to find IRAP, which is essential to the discussion, and to page 60 to find collaboration between universities and industry, and to page 48, and so on. Am I free to range over the whole brief in my questioning?

The Chairman: It is almost 5 o'clock, so you can start.

Senator Grosart: I am not dealing with specific projects yet. The first question I will ask, Mr. Chairman, is in connection with a statement on page 21. I will go back to page 20 in a minute. The statement in question is:

These and other approaches are directed toward a more effective transfer of technology from NRC Laboratories to industry.

And on page 59 we find exactly the same statement:

The National Research Council emphasizes the transfer of technology from its Laboratories to industry.

And that statement is more or less repeated several times through the brief.

I am particularly interested in the changes which may have taken place in the conceptual approaches of NRC to its terms of reference—changes which have taken place since you were here six years ago when we discussed them in quite some detail.

What would you say is the present status of the "more effective transfer of technology" from NRC laboratories today compared to what it was a few years ago?

Dr. Schneider: I wonder if you would repeat your question, senator.

Senator Grosart: The present status of the more effective transfer of technology from NRC laboratories to industry. I am reading from page 21 and again from page 59. I do not want you to go into the methodology you are using. We will come to that later. Have you actually brought about a substantial transfer of technology from NRC labs to industry?

Dr. Schneider: I would say yes, I think we are doing it now. To explain the process and the sort of conceptual difference, if you like, the difficulty previously was, if we developed some new technology or new device in the laboratory, to get it out to industry. The further we go down that road to develop it and it is a fairly sophisticated thing, the more trouble there will be in transferring it. We have in the past had these things patented and tried to license them through Canadian Patents and Development Limited. Time and time again we have run into difficulties in which firms interested in picking them up, who could see markets for them, had great difficulty in getting hold of them and putting them in place. It was obvious that they needed much more technical help. For a time we did use a kind of a dodge, because the program happened to be there; that was the PAIT program in the Department of Industry, Trade and Commerce.

Senator Grosart: If you don't mind me interrupting, Doctor; that is not my question. I know you have all kinds of types of methodology, but I am thinking of the quantitative result to date. How much transfer of technology is taking place today from your labs into industry today? That is my first question and I will discuss some of the methodology in a moment, together with the problems, because you are going into problems, quite properly, which we have gone into with officials of the Department of Industry, Trade and Commerce. I believe we know the reasons for it being difficult.

Dr. Schneider: I do not know how much detail you wish me to go into, because this now touches on the PILP program to which we referred earlier, the Pilot Industry Laboratory Program.

Senator Grosart: Let us take the total quantum.

Dr. Schneider: I mean, this is part of the total quantity and also the licensing that is done through CPDL.

Senator Grosart: No, but these are all methods; what has happened?

Dr. Schneider: We must look at this if you want the total quantity.

Senator Grosart: Well, give it to me in dollars, or numbers of projects that have actually been transferred?

Dr. R. D. Hiscocks, Vice-President, Industry, National Research Council of Canada: One new program involves approximately 24 projects, in which industry people are collaborating closely with our laboratories.

Senator Grosart: No. I am asking you about the actual transfer from a lab into industry.

Dr. Hiscocks: This is why they are working in our laboratories to pick up bench science.

Senator Grosart: Has an actual transfer taken place from the lab into industry?

Dr. Hiscocks: In this particular program, about \$0.8 million worth last year; \$2.1 million worth this year.

Senator Grosart: Of technology transfer, or research transfers?

Dr. Hiscocks: Research leading to new technology.

Dr. Schneider: I think if you could be more precise, senator, because we are mixing up dollars and people and numbers of projects. I am not quite clear as to exactly the type of answer you are seeking.

Senator Grosart: You say transfer of technology?

Dr. Schneider: Right.

Senator Grosart: It is not hard to get a description of technology and transfer means taken from point A to point B.

Dr. Schneider: That is correct.

Senator Grosart: What is the quantity of this? I am not saying it should be greater, or less in number of projects; was it zero six years ago and is it now on a comparative basis zero plus six?

Dr. Schneider: Previously the main vehicle was simply licensing through Canadian Patents and Development Limited. The numbers we can get for six years ago, but it would be how many licences per year, Dr. Hiscocks?

Dr. Hiscocks: CPDL processes approximately 40 good licences per year.

Dr. Schneider: Now, in addition to that route we have started the Pilot Industry Laboratory Program, which is in its first year.

Dr. Hiscocks: Currently under contract there are approximately 24 projects.

Dr. Schneider: These are in process; some will take several years. We hope to expand this next year, if we can obtain the funds to enlarge this quite substantially.

Senator Grosart: You describe this in detail at page 49 and you say that this assists in the transfer of technology to Canadian industry. Let me return, then, to your joint NRC-industry teams; what are they doing? This appears under the heading "Transfer of Technology".

Dr. Hiscocks: Again I am afraid we must talk of projects, but to the extent that I can generalize, they come to our laboratories and work with their opposite numbers in the laboratories, looking at the research which, hopefully, will lead to new technology at a fairly early stage. They work with our own scientists and engineers and if a project shows promise it is transferred to industry. This may proceed slowly and it may be over a period of two to five years, that transfer is made to the firm, a prototype is built and commercial possibilities assessed together with costs, possibly by means of a pilot plant. There is a gradual transfer from the laboratory to the firm. That is the principle.

Senator Grosart: What is the interface, then, between development and research in the lab and industry? Do you notify the people you think might be interested? How does industry find out that you have something in the lab that might be transferable to them?

Dr. Hiscocks: Through communications between people who are working in related areas, and through publications. The small firm patents and developments section issues a list of promising looking inventions. It is largely

word of mouth, through literature, seminars, associate committees. There are many communications.

Senator Hicks: In some instances your work might be initiated as a result of requests, inquiries or communications from industry, too.

Dr. Hiscocks: Yes. It is very difficult at times to know who initiated the work.

Senator Hicks: Who started it?

Dr. Hiscocks: Yes.

Senator Grosart: You make that clear here. It can be initiated by industry or NRC.

The Chairman: How many teams do you have at the moment?

Dr. Hiscocks: They come and go.

Mr. W. A. Cumming, Vice-President, Laboratories, National Research Council of Canada: I would say perhaps as many as ten.

Dr. Hiscocks: I would say there are ten active in the laboratories now out of the 24 projects I mentioned. With all of the 24 there are active communications with industry, so men from our labs would be in a number of these firms today, or representatives of the firms would be working in our laboratories today, but not necessarily all are on a yearly basis.

Senator Grosart: What percentage would you say are basically situated in industry? These teams must have a base. Some of them would be in the lab, some would be in industry.

Dr. Hiscocks: All the 24 firms I mentioned have some research strength. With a small firm it may be only one or two people; others will have quite large teams.

Senator Hicks: In their own premises?

Dr. Hiscocks: In their own premises, we would not normally accommodate more than five or eight in our laboratories.

Senator Hicks: Of their people.

Dr. Hiscocks: Of their people.

Senator Hicks: You might accommodate as many as that?

Dr. Hiscocks: I think we have had that many.

Senator Hicks: For what periods of time?

Mr. Cumming: Two or three years. In some cases there will be an on-going development. I am thinking perhaps of the one on the thrust meter for jet engines done co-operatively with Leigh Instruments that went on for a period of about three years.

Senator Hicks: As much as that.

Senator Carter: Would there be a similar number of your staff? If they had eight from industry, would you have eight from your staff working with them?

Dr. Hiscocks: Not often that many living with the firm, but quite a few visits back and forth and people staying for a week at a time, say.

Senator Grosart: I would now like to jump to page 49 to ask about these three main "contracting out" programs—the pilot industry lab program that you mentioned, the unsolicited proposals and the direct contacts. How far has the contracting out policy gone? Can you give us some indication of how many projects there are and what kind of money is involved? I am trying somehow to place this within your whole operation. That is the support for industry. I am not being critical. I am trying to find out what it is. I would like to believe that it is very substantial compared with what it was six years ago, when this committee reported that in the transfer of technology from labs to industry we were at the bottom of the ladder of all OECD countries. I am trying to find out if we have improved or are going to improve. I know you are trying. I am not being critical.

Dr. Schneider: First of all I would have to say that so far the effort has been modest. I have also had some concerns when talking about contracting out that we often include many things, such as studies and collecting data which are contracts, which for the manufacturing industry probably do not meet the objective, if the objective is to help build up their technological capability.

The best type of contracting out is the kind that requires them to push the state of the art and to develop new hardware. We have a number of such contracts. We think they are the most effective. I will mention only two: one was a large laser which we contracted out because we wanted this for research purposes. This requires the company to push the present state of the art.

Senator Hicks: But you want that for your own laboratories ultimately.

Dr. Schneider: Right. If we buy one, then they can go to various countries and say that NRC has bought one. This helps them. On a previous one we followed this route and they were very successful in selling it abroad. The other one I should like to mention, which is quite a large one, is connected with the post Apollo space program: the space shuttle. We are contracting with Canadian companies. It is also by intergovernmental agreement that Canada, as part of its space program, would participate in this, and NRC has been asked to the lead agency. Initially we are helping them to construct a large simulator, but the project is practically all contracted out to industry, a consortium of four companies which will be providing the remote manipulator arm, or tele-operator, attached to the space shuttle.

This program will total ultimately, according to current estimates, something close to \$75 million spread over three or four years.

That is the kind of thing which is pushing the state of the art, which you might call procurement. These are the best kinds of contracts to industry in this make-or-buy program.

We should look very hard at our government procurement, to see whether we could not channel more of our requirements where the government is the client or the customer in this route. That would do far more for the make-or-buy program than some of the other small study contracts which are really not going to meet the objectives.

Senator Hicks: When you make these contracts, I suppose they have to be cost-plus contracts of some kind because the ultimate result is too uncertain to give a fixed price.

Dr. Schneider: If it is entirely new equipment that is required, where there is some research and development required, then I would certainly say the R&D should be part of the plus, because, rather than inviting a lot of bids from offshore, if we were prepared to pay that plus and get Canadian industry to do it, we would do far more to help upgrade the capability of Canadian industry and then, ultimately, for them to be competitive in these areas.

Senator Grosart: Are you really suggesting, Dr. Schneider, and I hope you are, that it should be government policy to follow somewhat along the lines of the Japanese plan of business and government getting together on these projects in the many ways that both need the help of the other? Is that what you are suggesting here?

Dr. Schneider: Right, and I would say many other countries besides Japan follow that course as well.

Senator Grosart: Yes.

Dr. Schneider: I think where government has quite a lot of procurement need we should look at this whole area. I hope this might also include crown companies.

Senator Grosart: The Pilot Industry Laboratory Program is more specifically directed to the transfer function. You give us several interesting examples. How is this distinct from the other programs?

Dr. Schneider: It is distinct, for example, from the IRAP program in that the IRAP projects that come to us are projects developed by industry. These are things they want to do and they are prepared to invest some money in them. So they are done on a shared-cost program basis, as you know. Some of the ones under PILP are ones very often that we have developed in the laboratories. We think they are of great promise. We want to get them out in industry. It is very important that we get industry on board fairly early and help them in this transfer process.

Senator Grosart: What is the function of the industrial programs office? I am on page 51 now.

Dr. Schneider: I would ask Dr. Hiscocks to respond to that since he is responsible for it.

Dr. Hiscocks: We look after the IRAP and PILP programs. We are responsible to a major extent for the operation of the Crown Company, Canadian Patents and Development Limited. We assist in the examination of unsolicited proposals that come in through the Department of Supply and Services and suggest the ones that would seem to merit support, the ones that are of particular interest to NRC perhaps, and generally, provide a liaison between our own laboratories and industry.

Senator Grosart: Are you getting a sympathetic reaction from Supply and Services on the procurement side of the picture?

Dr. Hiscocks: I think we have good service from that department, in placing contracts.

Senator Grosart: I will come, if I may, to the IRAP programs, and that takes me to page 64. This goes back a long time, to 1961. I think it is the only one of these industrial grant programs that you actually administer, is that right?

Dr. Hiscocks: That is right.

Senator Grosart: You have a committee on industrial research set up and it operates the IRAP program?

Dr. Hiscocks: Yes. We have a secretariat that does the administration. A small committee representative of various government departments, including agriculture, screens and assesses proposals from industry.

Senator Grosart: I am looking for a table. Yes, it is on page 37. This is going a little way off the immediate subject but I think it is relevant, Mr. Chairman. This is the regional pattern of spending and much of it, of course, we would presume have been directed to the transfer of technology. The total amount here is \$163 million, \$65 million of that appears to be spent in the National Capital Region as against \$741,000 in the rest of Ontario, compared with very large amounts—I am speaking of the intramural—in other provinces. What is the explanation of that?

Dr. Schneider: Most of our laboratories, as you know, are here in Ottawa. We have some regional laboratories. One of the policies now accepted by our Council and also in line with recent government policy, is for a greater degree of centralization and we are, in fact, . . .

The Chairman: Decentralization.

Dr. Schneider: Yes, decentralization.—This is part of the explanation.

Senator Grosart: The location of the labs?

Dr. Schneider: Yes.

Senator Grosart: Which you compensate for by comparatively larger grants elsewhere in Ontario, extramural-ly?

Dr. Schneider: This is the next column, extramural, and would be mostly to universities and some to industry which would be a smaller amount.

Senator Hicks: Would the extramural include all the research grants in that area?

Dr. Schneider: Yes.

Senator Hicks: To individuals as well as to projects?

Dr. Schneider: Research grants to universities and also the IRAP grants to industry would be covered in the extramural.

The Chairman: I would have thought, Senator Grosart, you were going to ask the question about the share that Quebec gets.

Senator Grosart: No, that is not a line of questioning that bothers me very much.

Going on to page 69, and dealing with the patents, they are represented in a table elsewhere.

Dr. Hiscocks: Yes, the table on page 70.

Senator Grosart: I add up the total amount of patents from the beginning, from 1968, to something like \$5 million. This is the yearly value of production from all NRC licences. It is given in thousands. Am I correct in saying that from 1968 to 1974 the total value of production from all NRC licences is only \$5 million? Is my arithmetic correct? I am adding 589, 685, 721, 666, 914, 824 and 983, which is the series through the years 1968 to 1975. The table says it is

not available for 1976. Is this an adequate performance, do you think, \$5 million value of all these patents?

Dr. Hiscocks: I cannot explain those numbers. I think we shall have to dig into them. I would prefer to talk about royalties originating from NRC inventions, the percentage that the royalty represents. In other words, if we collect a 5 per cent royalty, it represents 20 times that amount of business for the firm. I am sorry that arithmetic is not here.

Senator Grosart: The phrase used is "value of production from NRC licences," \$5,382,000 in seven years. That does not seem right to me.

Dr. Hiscocks: No; I am sorry, we will have to clarify that.

Senator Grosart: You will check the table?

Dr. Hiscocks: Yes.

Senator Grosart: Let me leave that for the time being. Mr. Chairman, as you have asked me, I would like to ask some questions about the prospects of some of the projects that were given us six years ago. I made a list of some that looked promising, and I would like to find out how promising they have proved to be, and compare that with the promise of the 1,500 projects that are listed in this year's presentation.

The Chairman: Before you go on, Senator Grosart, I would like to mention, in case we forget, that when we are through with the discussion on these projects, and former projects, we shall have to come back to page 22, "Relations with Universities."

Senator Grosart: Yes. I just carried the relations with industry through to where I found some items in the report.

The Chairman: So we are now on page 149.

Senator Hicks: I have one question supplementary to the table commencing on page 71. I am correct, I think, in assuming that these are patents granted only to members of NRC staff?

Dr. Hiscocks: That is correct.

Senator Grosart: Mr. Chairman, perhaps we should carry on from where we were. There is not much sense in taking 10 minutes to start on the 1,500 projects.

The Chairman: Yes. We will take this next week as our first item.

Senator Hicks: I am not clear, Mr. Chairman. Where are we going to start next week?

The Chairman: At page 149. We now come back to page 22. Are there any questions on the section entitled "Relations with Universities"? I myself have a question which is related to the tragedy described later on, about the aging of personnel in NRC. You say, at the top of page 23 that:

NRC continues to encourage the interchange of scientific and engineering personnel between NRC and university laboratories.

Could you be more specific about this? Could you mention any number? Are they transferred on a permanent or temporary basis, for what time, and so on?

Dr. Schneider: These are on a temporary basis. You have a long listing at the back of personnel from various places

who have spent some time as visiting scientists in NRC laboratories. The largest component of this would be either people taking a sabbatical from their university post and working at NRC, or coming to us during the summer months. This is the most common form.

The Chairman: I am more interested now, not in that aspect—because we will come to it later—but exchanges from NRC to universities, rather than the reverse.

Dr. Schneider: Yes. These happen from time to time, but at the present time not on a large scale. Occasionally our staff members are asked to give courses during a term at a university, which may take so many hours a week, and we do encourage this. It is particularly common at the Ottawa universities, and in Saskatoon, and in Halifax.

Senator Hicks: Many of the scientists at the Atlantic research laboratories are honorary members of our faculty of graduate studies. They may give courses, they certainly supervise doctoral and post-doctoral students. Space is made available for our people to work in their laboratories, and theirs to work in ours. The co-operation could not be more meaningful.

Dr. Schneider: And it is a two-way process, of course. There are university professors who have very close contacts and do exterior work in our laboratories, and they sometimes bring their graduate students with them.

The Chairman: But you have no program, and you do not encourage people working in your laboratories to move for a number of years, or more or less permanently, to universities.

Dr. Schneider: Well, if it is permanently, then it is really more than just an exchange.

The Chairman: Well, it is an exchange.

Dr. Schneider: It does happen to some extent for a year, perhaps, and we have had several at the University of Laval who have accomplished two purposes. One is the carrying out of research there, but at the same time working in a bilingual environment to perfect their competence in French. This has worked very well, and I think the University of Laval has been most co-operative in this respect.

Senator Grosart: I have one question on that, Mr. Chairman. You referred to a program of fellowships to ensure that doctoral graduates will seek industrial careers. Has that been successful? That is at page 60, I think.

Dr. Schneider: It is a program involving our post-doctoral people.

Senator Grosart: We hear often from industry that it would be very desirable to divert some Ph.Ds from the eternal career of teaching.

Dr. P. Grenier (Member, National Research Council of Canada): Perhaps I can give some figures on that. The number of such scholarships in 1960 was nine. In 1970 it was 23, and went up to 36 the following year, then to 68, then to 98, and then to 115. We like to consider that this is one of our most successful programs, not because of the numbers, but because of the percentage of these people that industry—which, during the tenure of the fellowship, pays the difference between the normal salary of a doctor and a fellowship—retains, because they appreciate them and find them useful. I think we are gradually convincing

industry that the Ph.D. is not a really bad thing at all, but that it can be useful.

Senator Hicks: Have you any figures as to the proportion that may be retained by industry? Just a ball park figure?

Dr. Grenier: A ball park figure would be 72 per cent. I have heard this figure somewhere in meetings.

Senator Grosart: They actually stay in industry and make their careers in industry?

Dr. Grenier: Yes.

Senator Grosart: That is a very significant way of transferring technology.

The Chairman: Or at least, knowledge.

Senator Grosart: Technology too.

Dr. Grenier: I come back to your previous question. I guess the difficulty was to define a unit of technology. It has a value in a laboratory, but, depending on the size of the industry, from the research point of view, it may be of the same value, or, depending on the kind of industry the individual goes to, may have a totally different value with regard to jobs, or product, or investigation, and so on. I fully realize what kind of answer you are looking for, it would be some sort of quantitative data; but the value is very difficult to estimate, depending on the point of origin and the point of arrival.

Senator Grosart: I made the remark that assuming that a Ph.D. wants to get into industry, he is to some extent a technologist, and if you are transferring a technologist you are bound to be transferring technology, unless he has forgotten it.

Dr. Schneider: If I could answer this, the last time we met with you we were concerned about this bump that was arising consisting of the number of new Ph.D.s, and we could also see that there would be fewer opportunities in universities, so that we were looking for other options for these people. We felt that we had to provide something other than the usual post-doctoral fellowship that we give, which, by and large, has been used to prepare an individual for an academic career, and we felt we should offer the opportunity to obtain a career in industry; but there was a need to break down bias on both sides, I think. There was a bias on the side of industry that the Ph.D. was overtrained and not really very useful, whereas the bias on the part of the students was the fact that industry would not really have very interesting challenges to offer.

We did not believe either of those views. We felt we had to break down those biases, and the only way was to get them together. Industry accepted the proposals for this program very enthusiastically. We are very happy at the way it is turning out. It is more or less the way we had hoped. We were sure that once they proved their worth, they would generate a demand for more in industry. We also did not insist that they do research in industry. We are content that they be prepared to accept whatever challenge industry presents.

Another encouraging factor was that they did not necessarily seek out the large companies with large established R&D labs, but also the smaller, innovating companies where they thought there were really challenging opportunities.

Senator Grosart: Is a substantial percentage of these individuals becoming executive of these firms rather than research directors?

Dr. Schneider: We do not have any figures on that, senator, but dealing with those who chose the smaller companies, they will be expected to more than just work at a lab bench. In a small company, you have to be prepared to be fairly versatile.

Dr. Hiscocks: Two firms, one very large and one very small, have said that the man will be president of the organization some day.

Senator Grosart: You have not developed yet a route 128 such as they had in Boston?

Dr. Schneider: I think that concept is passé.

The Chairman: It worked very well.

Dr. Schneider: Yes, as long as there were numerous defence and space contracts.

Senator Grosart: And as long as the MIT people were in Washington having some say in procurement.

The Chairman: Shall we deal with the section on international representation? I have at least two questions on that section.

Senator Carter: Is this the time to ask questions about the U.S.S.R. Academy of Sciences, Mr. Chairman?

The Chairman: Yes. It commences on page 23 of the brief, but relates to a previous section.

As you will recall, Dr. Schneider, we recommended in our third report that international relations at the private level...

Dr. Schneider: The non-governmental level.

The Chairman:—The non-governmental level, the private level—should be assigned to some private association. We suggested the Royal Society, and other suggestions have been made. As I understand it, there has been no change in that respect; that insofar as these international relations are concerned, NRC still has the responsibility of providing the money, and so forth, although it does work with private associations.

Dr. Schneider: That is correct. There have been some discussions, particularly with the Royal Society, but also with other societies. The Royal Society is making quite a determined effort to bring the various scientific societies together to see whether they can come to some understanding and perhaps form some kind of umbrella association.

The only difficulty it has run into is that the engineering societies at the present time are not very happy with such a move. In a way, we would not like to see the engineering societies go their separate ways, or have this split between the basic and applied sciences. We would prefer that there be one body that can bring together both the engineering societies and the other scientific societies. We have expressed this view to the Royal Society and it is working on it. I do not know whether it will succeed. Certainly, at the beginning of discussions, the engineering societies took quite a strong stand, but this may be softening. The Royal Society has given them other options to work on. Agreement may still be reached on such an umbrella association, so they may still come out with some kind of result.

The Chairman: But provided there is some kind of arrangement and understanding, you would have no objection yourself to giving up that function?

Dr. Schneider: No, provided there is a responsible body which is representative of the scientific community, this is a real possibility. Whether the Royal Society can pull it off remains to be seen.

The Chairman: Any further questions?

I have one myself. You seem to have various agreements with other countries, specifically with the Soviet Union, Poland and Czechoslovakia. I have also seen in your list of visiting scientists quite a number coming from the Soviet bloc countries and they are working within the NRC. How does this work in terms of national security for instance?

Dr. Schneider: This is not a problem. It is really, I think, a matter for the particular man. Supposing a scientist wants to come to work in Canada, then he has to get permission and visas from his own country. Why it is necessary to have a formal agreement sometimes is in case there should be problems of currency exchanges and so on. But by and large I think the climate has changed quite a bit since we first negotiated an agreement with the Soviet Union which goes back quite a long way. Things are much easier now and with the other east European countries as well, it is now generally quite easy. Many of them would like to have more formal agreements with us. Our difficulty is that scientifically speaking we are still a small country and if we engage in formal agreements with too many countries, we won't have a scientist left at home to do any work. They will all be abroad because we have to deliver so many each year on a quota basis.

The Chairman: I don't think you are really dealing with my worry. These people come to NRC and of course would be aware of all kinds of secret research that is going on within NRC and would be able to go back to their own countries with this information.

Dr. Schneider: We are not doing any secret research, so I don't think there is any difficulty there. I should also say that some of these people are not necessarily working in NRC. They may work in other government departments under the exchange program, for example, with the Soviet Union.

The Chairman: Do we have Canadian scientists, for example, going to work in labs in the Soviet Union?

Dr. Schneider: Yes. There is a quota system; a number of man-years or man-months is exchanged every year.

Senator Carter: In exchanging information between Canada and the Soviet Union, can you tell us something about some information we got from them that has been of special benefit to us?

Dr. Schneider: Yes. In the basic science area, this is quite easy. There is really no problem there and there are number of areas where they are quite advanced. This applies to lasers as it might be applied to thermonuclear fusion. They were, perhaps, in the lead there, and we have need access to this information. Then there is MHD—magnetohydrodynamics is another one in which they are also very much in the lead, and certainly in some of the other areas of physics they are quite advanced. However, when you get to the technology area and sometimes also for northern problems, things become a little stickier.

Senator Hicks: Meaning what—that they are more reluctant to give it?

Dr. Schneider: Yes, but in the science area generally there is no difficulty.

Senator Carter: Are you saying that they are quite willing to give us the information that we can get from other sources, for instance from Great Britain or elsewhere, but when it comes to information which we cannot obtain elsewhere they are more reluctant?

Dr. Schneider: No, we have no reason to believe that any of our scientists who have been in the Soviet Union, excepting for a few exceptions such as geologists who wish to travel to outlying areas of the country, or the northern areas, but people who have spent some time in a Soviet research station find that they are quite open and they have access to everything. If they can speak Russian, it is so much the better, because it is then easier to exchange information. We have no reason to believe that they withhold anything. On the other side of the coin, those who come here from Russia get a quite open reception and exchange of information including our research journals.

Senator Lang: Are they allowed to travel in our north country?

Dr. Schneider: They would like to very much, and here we have been very generous. However, sometimes trying to do the same thing in the Soviet Union is not so easy.

Senator Lang: Is their interest scientific, or military?

Dr. Schneider: I believe they are primarily interested in the scientific end of it, but their other interests, I don't know.

Senator Grosart: Do you have any research projects at NRC that you would regard as having a high security rating?

Dr. Schneider: I would say no. Again, I suppose you know of the one program that was transferred . . .

The Chairman: And was well publicized.

Dr. Schneider: So I can say no.

The Chairman: We will adjourn now and start next week at page 149 of the brief, returning after that to page 25.

The Committee adjourned.

APPENDIX "20"

OFFICERS AND MEMBERS OF THE
NATIONAL RESEARCH COUNCIL OF CANADA, 1976

W. G. Schneider, President, National Research Council of Canada, Ottawa, Ontario.

P. W. Allderdice, Associate Professor of Cytogenetics, Faculty of Medicine, Memorial University of Newfoundland, St. John's, Newfoundland.

O. C. W. Allenby, Manager, Research Division, Du Pont of Canada Limited, Montreal, Quebec.

A. D. Booth, President, Lakehead University, Thunder Bay, Ontario.

M. Brossard, Recteur, Université du Québec à Montréal, Montréal, Québec.

G. G. Cloutier, Directeur adjoint, Institut de recherche de l'Hydro-Québec, Varennes, Québec.

W. A. Cumming, Vice-President (Laboratories), National Research Council of Canada, Ottawa, Ontario.

J. S. Dupré, Chairman, Ontario Council on University Affairs, Toronto, Ontario.

D. A. Eisenhauer, President, Atlantic Bridge Company Limited, Lunenburg, Nova Scotia.

G. Gascon, Trudeau, Gascon, Lalancette et Associés, Montréal, Québec.

B. A. Gingras, Vice-président (Subventions et bourses universitaires), Conseil national de recherches du Canada, Ottawa, Ontario.

P. Grenier, Doyen, Faculté des Sciences et de Génie, Université Laval, Québec, Québec.

R. R. Haering, Professor and Head of Physics, University of British Columbia, Vancouver, British Columbia.

R. H. Haynes, Professor, Department of Biology, York University, Downsview, Ontario.

R. D. Hiscocks, Vice-President (Industry), National Research Council of Canada, Ottawa, Ontario.

R. U. Lemieux, Professor of Organic Chemistry, Department of Chemistry, The University of Alberta, Edmonton, Alberta.

J. S. MacDonald, President, MacDonald, Dettwiler & Associates Limited, Vancouver, British Columbia.

V. N. Mackiw, Executive Vice-President, Sherritt Gordon Mines Limited, Toronto, Ontario.

D. E. Munn, Regional Vice-President, International Nickel Company of Canada Limited, Winnipeg, Manitoba.

P. N. Nikiforuk, Dean of Engineering, University of Saskatchewan, Saskatoon, Saskatchewan.

H. W. Quinn, Manufacturing Manager, Flexible Packaging Department, Dow Chemical of Canada Limited, Weston, Ontario.

B. D. Leddy, Secretary of the Council, National Research Council of Canada, Ottawa, Ontario.

G. M. Brown, President, Medical Research Council, Ottawa, Ontario.

F. Depocas, Directeur adjoint, Division des sciences biologiques, Conseil national de recherches du Canada, Ottawa, Ontario.

F. A. Milligan, Associate Director for University Affairs, The Canada Council, Ottawa, Ontario.

E. H. Richardson, Herzberg Institute of Astrophysics, National Research Council of Canada, Victoria, British Columbia.

Canada. Parliament. Senate. Standing Committee
on Science Policy
Proceedings...

Lacking issue no. 13; 30th Parl., 1st session.



Government
Publications

FIRST SESSION—THIRTIETH PARLIAMENT
1974-76

THE SENATE OF CANADA
PROCEEDINGS OF THE
SPECIAL COMMITTEE OF THE SENATE ON
SCIENCE POLICY

The Honourable MAURICE LAMONTAGNE, P.C., *Chairman*

Issue No. 14

WEDNESDAY, JUNE 9, 1976

Fourteenth Proceedings on:

The Study of Canadian Government and other
expenditures on scientific activities
and matters related thereto.

(Witnesses and appendices: See Minutes of Proceedings)

THE SPECIAL COMMITTEE OF THE
SENATE ON SCIENCE POLICY

The Honourable Maurice Lamontagne, P.C., *Chairman*,

The Honourable Donald Cameron, *Deputy Chairman*.

AND

The Honourable Senators:

Asselin	Hastings
Bélisle	Hicks
Bell	Lang
Blois	Manning
Bonnel	Neiman
Bourget	Riel
Buckwold	Robichaud
Carter	Rowe
Giguère	Stanbury
Godfrey	Thompson
Goldenberg	van Roggen
Grosart	Yuzyk
Haig	

27 Members

(Quorum 5)

Order of Reference

Extract from the First Report of the Special Committee of the Senate on Science Policy, presented on July 10, 1975 and printed as an Appendix to the Minutes of the Proceedings of the Senate of that day, and adopted by the Senate on July 24, 1975:

"The Committee, therefore, recommends that it be authorized to consider and report on Canadian government and other expenditures on scientific activities and matters related thereto;

That the Committee have power to engage the services of such counsel and clerical personnel as may be necessary for the purpose of the inquiry;

That the Committee have power to send for persons, papers and records, to sit during adjournments of the Senate and to report from time to time; and

That the Committee be authorized to print such papers and evidence from day to day as may be ordered by the Committee."

Robert Fortier,
Clerk of the Senate

Minutes of Proceedings

Wednesday, June 9, 1976
(23)

Pursuant to adjournment and notice the Special Committee of the Senate on Science Policy met this day at 3:35 p.m., the Chairman, the Honourable Senator Lamontagne, presiding.

Present: The Honourable Senators Asselin, Bell, Bourget, Cameron, Godfrey, Grosart, Hicks, Lamontagne, Neiman, Rowe, Thompson and Yuzyk. (12)

Present but not of the Committee: The Honourable Senator Greene.

In attendance: Mr. Philip J. Pocock, Director of Research.

The Committee resumed consideration of its Order of Reference dated July 24, 1975 relating to the study of Canadian Government and other expenditures on scientific activities and matters related thereto.

The following witnesses from the *National Research Council of Canada* were heard:

Dr. W. G. Schneider, President;

Mr. W. A. Cumming, Vice-President,
Laboratories

Dr. R. D. Hiscocks, Vice-President,
Industry;

Dr. B. A. Gingras, Vice-President,
University Grants and Scholarships.

Dr. Schneider tabled and commented on a document entitled "National Research Council of Canada, Revenue 1975-76 and Financial Encumbrances from Federal Government Departments & Agencies, 1975-76". The Committee *Agreed* to print this document as an appendix to the Committee Proceedings of this day. (*See Appendix No. "24"*).

In accordance with the motion passed on Wednesday, May 19, 1976, extracts only from the brief submitted by the National Research Council of Canada are printed as Appendix No. "25" in this day's Proceedings. An additional document entitled "Review of certain Research Projects that were described in case histories in 1968 by the National Research Council of Canada—26 May 1976" is printed as *Appendix No. "26"*.

The witnesses answered questions put to them by Members of the Committee.

At 5:22 p.m. the Committee adjourned to the call of the Chairman.

ATTEST:

Patrick Savoie,
Clerk of the Committee.

The Special Committee of the Senate on Science Policy

Evidence

Ottawa, Wednesday, June 9, 1976.

The Special Committee of the Senate on Science Policy met this day at 3.35 p.m. to consider Canadian government and other expenditures on scientific activities and matters relating thereto.

Senator Maurice Lamontagne (*Chairman*) in the Chair.

The Chairman: Honourable senators, before we continue our questioning on the brief I would like to ask Dr. Schneider to explain a table that has been prepared. I do not know if this has been made available to members of the committee, but it is the table that I asked to be prepared last week, concerning mainly the revenues that NRC gets from other departments as a result of contracts with them, and which do not appear in their ordinary votes.

Dr. W. G. Schneider, President, National Research Council of Canada: Mr. Chairman, these are outside revenues, that is, revenues that are outside the votes that are provided to the National Research Council annually by Parliament.

We have divided them into two groups: the first consists of revenues that we are actually paid for services or publications; and the second consists of financial encumbrances. In the first group the revenues are credited to the vote, so that they will appear in our estimates, which means that the vote is reduced accordingly. The financial encumbrances appear in the estimates of other departments or agencies which have asked us to undertake work for them.

The first group, the revenues, which are for the fiscal year 1975-1976, amount to \$3,021,000, and are broken down, as you can see, into: laboratory services, \$1,686,000; publications, including research journals and the National Building Code and other publications, \$856,000; and then scientific and technical information services, for \$479,000, although we think that this latter amount, in the coming year, is likely to go up rather substantially.

With regard to the financial encumbrances, these are again for 1975-1976, and amount to \$5,609,000.

The Chairman: Thank you very much. I think this table should be printed as an appendix.

For table, see Appendix page 18.

Senator Grosart: May I ask one question? How is this \$5,609,000, under the heading of "financial encumbrances," shown on your books?

Dr. Schneider: In the internal accounting?

Senator Grosart: Yes. Does it show as income?

Dr. Schneider: Not as income. Perhaps I should ask Mr. Cumming about this.

Mr. W. A. Cumming, Vice-President, Laboratories, National Research Council of Canada: Mr. Chairman, the principle of financial encumbrances, of course, is that we act as an agent for other departments, and so, in the central accounting system we have, we do have an imprest account in which this money is separately accounted for. It does not appear in our estimates, but we do keep a separate accounting of the moneys that come in from the departments, the charges against the financial encumbrances, the free balance at any time, and, of course, there is an annual summary of whether or not the complete financial encumbrance was spent. So there is an accounting system to keep track of the financial encumbrances.

Senator Grosart: You have spent \$6 million. How do you get it back? Just as a bookkeeping entry?

Mr. Cumming: Oh yes.

Senator Hicks: I think I understand why laboratory and supporting services are there, but why are research grants and fellowships handled in this way?

Dr. Schneider: I also have a breakdown of that, and the largest item, which will change in the future, but which for this past year we still carry on the books, arises from the fact that we in effect acted as the agent for a number of other bodies, administering certain programs such as, for example, the Atomic Energy Control Board. All the grants that they had provided for nuclear physics, we essentially did the administration for. In the case of the Atmospheric and Environmental Services, we operate a scholarship program for them. With regard to CIDA and NRC associations, this is a program that brings young researchers from developing countries to Canada to work for a period with some expert in the field they are interested in. CIDA pays for this; we administer it. There are some exchange agreements also, for example, with Brazil, which CIDA pays for and which we administer. It is a program of scientific exchange. There is another one which is paid for by External Scientific Exchange with France.

Senator Hicks: These, of course, are all in addition to your regular research grants and fellowships.

Dr. Schneider: Yes. There are some NATO ones as well.

Senator Greene: Dr. Schneider, from your explanation of the revenue side of things, I gather that any earnings you make are still shown as a total in your estimates, and then, if you want to check the estimates carefully you can see that \$3 million is something you earned, and which did not come from the public trough; but would it not present a better picture to those who look statistically at government spending if they did not show at all, but rather showed that your total estimates were \$3 million less than they are shown to be, since that is all you are getting from the public? Because with regard to total government spending there are those among the public and parliamen-

tarians who total up that government spending and say, "Isn't it awful? It's up 19.3 per cent," whereas in that 19.3 per cent is included \$3 million that is not up in government spending but which is earned by you and does not come from public spending.

Dr. Schneider: That in fact is presented in our estimates in the blue book in precisely that way, in what, in other words, is called the total program, which reflects the total work we do and its cost. It also shows separately our recoveries, and then there is the vote, which shows our recoveries subtracted from the total, so that the actual vote is reduced and is smaller than the cost of the total program as a result.

Senator Greene: The vote is for \$3 million less than the cost of your total program.

Dr. Schneider: That is right.

Senator Grosart: It is like a \$1 item.

The Chairman: Before we go back to the brief, I have noted that Dr. Schneider has already referred several times to the so-called PILP program, without being really able to explain it.

Senator Asselin: What does it mean?

The Chairman: I will ask Dr. Schneider to explain, and will therefore invite him now to give us more information on that program.

Senator Grosart: He has waited patiently.

Dr. Schneider: Mr. Chairman, this is a program which resulted in the course of development of what we call our redefined role. We have looked at what we see to be the present needs and the priorities for the future, and one of the areas we have identified is to make the programs that we have to assist industrial research and to assist industries, not to compete with but rather to complement what is being done by industry and to have industry undertake, as far as possible, those things that they are best able to do. That would be product development and process development, and this sort of thing. Because in the past we had encountered many difficulties in transferring technology from the laboratories to industry, we felt we had to find a better solution for this.

Senator Greene: Is this program of yours undertaken with the pontifical benediction of I.T. & C.?

Dr. Schneider: Any program relating to industry we always discuss with IT & C, and we do have very close co-operation with the department. Basically this program is aimed at getting some of the good, promising ideas out of the laboratory and into industry and having them exploited in industry. One of the problems we have had is that in a number of cases these ideas will have been covered by a patent, and Canadian Patents and Development, which is a subsidiary company of NRC, would attempt to license this to industry and, of course, giving preference to Canadian industry, to attempt to get commercial exploitation. We have had some difficulty because very often, if it is a fairly sophisticated thing, industry has had difficulty picking it up and then carrying it through to development and into the production phase. So we felt that there was needed an intermediate step where there was not merely a question of financial assistance but technical assistance and technical backup. So we have

attempted to do this, and this takes several forms. First of all, we call this a Pilot Industry Laboratory Program. It is essentially a co-operative program with Canadian industry and our laboratories. In many cases if the industry is interested in exploiting a particular development they will send their people into the laboratory to work with our people to pick up the technology, and we will help them, in some cases through contracts if necessary. But the main aim is to try to get a smooth transfer of the technology to industry to bring industry on board at the earliest possible moment to co-operate in the project. Essentially, the laboratories will only carry the particular project to a point where feasibility has been demonstrated on a laboratory scale because if it looks very promising and if there is an obvious market, then the sooner we can get it out of the laboratory, the better. The best way to do this is to get industry involved at that point and ask them to undertake the development—building a prototype or pilot plant. This is why we call it PILP—Pilot Industry Laboratory Program—and our council has decided that this is a very good program, and we should try it out on a three-year basis and make a thorough assessment of it and if it is successful, we will go full tilt ahead.

We have just completed one year and we are going into the second year and, so far as I can see, it looks extremely promising. We think that this is one of the best mechanisms or instruments we have devised so far to get a smooth transfer of technology and good ideas that have high promise from the laboratories into industry. Very often with a company which is taking this on, we can provide a contract for the development work. This is part of the contracting-out policy. In other words, we give them some financial assistance, but more important in this case, we give them technical assistance as well.

Senator Greene: You have lost me for a moment, doctor. Is this only patents or ideas or technology that originally emanates in NRC?

Dr. Schneider: That is correct.

Senator Greene: Are you plugged in to other science-oriented government departments so that the ideas that might come from there can go through the same funnel? I say that because I once had an experience with an antibiotic. It was one that we had discovered and we had no ready and practical method of moving it from the agricultural laboratory into the mainstream of the antibiotic industry in Canada. I think you are suggesting that if we had had that sort of a vehicle at that time, we might have been able to pump it through you.

Dr. Schneider: I think so, senator. I think that many that did not come off in the past would have been successful had we used this mechanism.

But to answer your question more directly, Canadian Patents and Development of course do handle the patents and disclosures from other government departments. But now, under the "make or buy" policy, they too can provide a development contract to industry, so I do not know whether at the present time we do have one in the PILP program from other departments or whether so far these emanate only from the National Research Council.

Dr. R. D. Hiscocks, Vice-President, Industry, National Research Council of Canada: It is difficult at times to know where bright ideas come from because several people have contributed, but certainly we do not rule out projects that come in under the "make or buy" program or

from other unsolicited sources. Most of the programs we are currently supporting did originate in NRC.

Senator Bourget: But for the moment the initiative came from NRC?

Dr. Schneider: All of those currently being funded, and I am happy to say that we did succeed in getting more funds into this program in the current year, and we hope to have even more in the third year. I think we can say that so far it looks extremely promising. There are all kinds of programs lining up for this route. Laboratory researchers are coming forward with these ideas and they are saying, "We think this is an excellent idea; is it possible to get it into the PILP program to get it out into industry?"

Senator Bourget: And is industry aware of that program?

Dr. Schneider: Yes. It is still relatively new and perhaps has not yet had as wide a publicity as it will have. Then when it does go on contract, it goes to DSS which is the same route as the make or buy program. They have a mechanism for notifying industry of what possibilities exist.

Senator Hicks: Approximately how many projects would be operating under this PILP program now?

Dr. Schneider: In the first year we started with a modest amount, and I think they are up to 14 under contract now and another dozen under negotiation.

Senator Neiman: Mr. Chairman, could we get an idea of the types of programs concentrated, for instance, in the engineering, medical and other fields?

Dr. Schneider: Yes, I can give you some idea, as I have a list of them with me. The analytical plotter, which is a photogrammetric plotter which I believe we mentioned when we were here last time is one. This is for aerial surveying. It is a rather sophisticated plotter, which immediately makes all the corrections and is capable of plotting a three-dimensional map from aerial photographs. This is done by a small built-in computer. This one, while the NRC had developed a previous one, is much more sophisticated. It is, I believe, perhaps the third generation now, which, of course, makes it possible to save much tedious reduction of photographs, which is now all done automatically. Of course, this is an area in which Canada is well advanced and a number of geophysical companies we have hold large contracts to carry out aerial surveying in other countries. With the detail that is now possible, including three dimensions, it is tremendously important for, let us say urban planners and developers and large projects such as airports and so on that require surveys of the terrain. The accuracy possible now is becoming of the same order as that which can be achieved on the ground with the surveying instruments people used to have but, of course, could not produce the three dimensions, the contours as well as this can.

Senator Hicks: With whom would you be co-operating?

Senator Godfrey: How do you choose the company?

Dr. Hiscocks: Instronics is a local firm which has worked with the group that is developing these instruments over a period of years. There is another company on the west coast known as Gestalt, with whom we are already co-operating. However, we have narrowed down this activity in support to two fronts.

Senator Thompson: Are those subsidiaries of American companies or are they Canadian companies?

Dr. Hiscocks: No, sir; they are Canadian-owned.

Senator Thompson: How many Canadian companies are there in this field?

Dr. Hiscocks: I think there are only really two prominent firms with a world-wide reputation in Canada and both are Canadian-owned.

Senator Rowe: Is that a requirement?

Dr. Hiscocks: We must take each case on its own merits, but nearly all these projects are with Canadian-owned firms. In some cases, however, they are subsidiaries. Bristol Aircraft, for instance, who are doing some windmill work for us, are a British company, but with a strong Canadian component.

Senator Hicks: How are the contracts carried on with Instronics?

Dr. Hiscocks: They are under contract to produce a prototype.

Senator Godfrey: Then they would supply the aerial surveys; they are not necessarily the aerial survey company themselves?

Dr. Hiscocks: Instronics is not.

Senator Greene: Do your general rules of operation take in overall government policy, such as to endeavour to put this kind of development which is nurtured by you and let the government define the areas of high unemployment or regionally depressed areas? Do you have as part of your rules that it may be better, for instance, to put a project in Nova Scotia than in Toronto? Or does that come within the realm of your operations?

Dr. Hiscocks: It is a consideration. Wherever possible we would certainly try to meet as many of our national objectives as possible.

The Chairman: I believe we should now return to the brief, to where we were during our last meeting, which was, as you will remember, entirely devoted to individual projects, past and present, their outcome and methods used in their selection.

I am afraid that we will not be able to cover each area contained in the brief, but must limit ourselves to a few of them. We were, as far as I can recall at the last meeting two weeks ago, at page 25 of the brief, which deals with relations with provincial research institutes. Are there any questions with respect to this particular paragraph?

Senator Grosart: Could we have a list of active provincial institutes, or perhaps the provinces which do not have them?

Dr. Schneider: I think there are very few provinces that do not have one now. Moving from east to west, there is the Nova Scotia Research Council.

Senator Hicks: It is research foundation.

Dr. Schneider: I beg your pardon; the Nova Scotia Research Foundation. The New Brunswick Productivity Council, which provides support in Prince Edward Island; there is the Centre de Recherche industrielle du Québec; the Ontario Research Foundation; the Manitoba Research

Council; the Saskatchewan Research Council; the Alberta Research Council; and the B.C. Research Council.

Senator Hicks: And Newfoundland?

Dr. Schneider: Not yet, that I am aware of.

Senator Grosart: That is a considerable extension of this activity at the provincial level since we started. I believe there were only three six or seven years ago.

Dr. Schneider: Yes; probably four or five.

Senator Greene: How do you determine which areas should be covered by these provincial bodies at the expense of provincial taxpayers and which are more properly done by yourselves?

Dr. Schneider: Normally this does not present a problem, senator. We will consider the sort of local problems which the provincial councils can handle and are in the best position to do so and in that event we do not become involved. If there is something for which they do not have the expertise or facilities, they may refer it to us. So this is what we refer to as working together with them in series, rather than in parallel. We do not want to duplicate their work, but rather complement it. We do this for example by jointly determining the best solution in the area of scientific and technical information dissemination. Very often small companies run into problems in connection with which they need some technical help and very often that information or technology is available but it is hidden away in the literature somewhere and these small companies do not have ready access to it. So it is a matter of, first of all, finding out what their problem is and, secondly, seeing if there is a solution available and getting that solution back to them in a form which they can immediately utilize. This is primarily a function of our technical information services, which is now part of our whole scientific and technical information complex, whereby we pay under contract the salaries of some people they engage in the provincial research councils to assist us essentially as field representatives in this technical information service. In many cases we also have some field industrial engineers who will visit small companies, because very often something goes wrong but the company is not in a position to be able to identify or analyze the problem in order to know what questions to ask us. So these industrial engineers visit them and find out what their problem is and see if we can find the solution.

Senator Thompson: Just on that point, do you have, for example, industrial engineers who visit in the area of housing?

Dr. Schneider: Housing can be included also. We do have a division of building research which has a number of field officers. They usually refer anything in the housing construction field to our people from the division of building research. We also have a number of regional offices.

In the other industrial manufacturing areas it usually comes through the technical information services route, and, as I say, here we co-operate very closely with provincial councils. In fact, they engage some of the field people and we pay them the salaries for those people. In some cases we also have field officers and they all work together.

Senator Thompson: The reason I asked the question was that I have some acquaintance with innovations that have been made in housing, and I understood it was impossible

to get anyone from NRC to go and look at certain innovations which were developed, and which in one case led to an exciting process which has been used around the world in high-rise buildings. The reason given for not being able to come was lack of staff and that NRC was under too much pressure to be able to go out and look at the site itself. Has that situation changed?

Dr. Schneider: Unfortunately, I am afraid that is still true, because we still have not enough staff to be able to pursue all of these problems. We do the best we can with the staff we have, but when it comes to making actual on-site visits we are limited. Certainly we make sure we follow up on inquiries that are sent in to us. We answer those.

The provincial research councils, as I say, have had a number of people working with us in the technical information services. Since NRC was asked a few years ago to try to develop this national network of scientific and technical information dissemination, we have now begun to develop it in a somewhat different mode. The ultimate form of co-operation which will emerge with the provincial research councils has yet to be developed. At present we have only one pilot experiment, because, first of all, before we spend too much money it is important to know what the main demands from industry are for scientific and technical information; what kind of information they need and how fast they have to have it, because that determines the cost, and also what they are prepared to pay for it, because once this national network gets set up it is our hope to be able to recover the operating costs. This is really meant to validate all of the parameters of this national network, which will include computer data banks and a lot of automated information services. These get somewhat expensive. On the other hand, if you use Telex or even Her Majesty's mail, although it costs much less, the turn-around time, or the time that they are prepared to wait to get the information, is related to how quickly they need it.

Senator Grosart: Is the ratio of problems referred by industry to the provincial research institutes substantially different from the ratio in NRC?

Dr. Schneider: If it is a small industry it would not be substantially different. By and large the larger companies, and particularly the one which have resident engineers and scientists, can find their way around the literature themselves quite easily. They might come to us, or in some cases the provincial councils, with some specific problem requiring test work or with some materials problem they have. The problem is likely to be more sophisticated.

Senator Thompson: It seems to me that with smaller companies which do not have a resident scientist or engineer the standard of your scientific writing in some cases might be incomprehensible to the layman who is on the job. I suspect that it is not used either in bakeries or in housing, where it might be too heavy for them to understand.

Dr. Schneider: We have been very much aware of that and we have taken great pains on that particular point to make sure—and that is what I meant before—that we supply them with this information in a form they can immediately use.

If the matter is more complicated, then it is taken to the industry by one of the field industrial engineers who will explain it to them and in fact even help them to implement

it. We are conscious of this problem. It is one we do have to pay special attention to.

Senator Greene: Where your information and technical help and so on enables a company to become productive and, hopefully, profitable, is there a pay back? Do you get paid for the ones which work or is it considered by industry as a handout from government?

Dr. Schneider: We do not get paid back in the sense that they pay us for the service. At least not yet. But certainly in terms of what it pays to the economy there are tremendous success stories. The cost benefit ratio here is high because in many cases an industry which was about to go under has become successful because we have given them assistance. It has turned the whole thing round and they are doing extremely well. There are many cases which have been documented in which sales volumes have gone up substantially as a result of improvements we were able to help them make.

Senator Greene: But industry looks upon this as its inalienable right from the public service rather than as something it should pay for. Is that not right?

Dr. Schneider: Well, the difficulty for us to charge at this particular point is that we cannot advertise broadly a service for which we do not at the moment have the resources or the manpower to be able to respond in order to make it a viable operation commercially. Once we have the national network developed it is our intention to recover the operating costs. In order to do that and plan this network intelligently we do have to do the pilot experiment which we are currently doing, and this setting up a referral centre in an industrial area and letting it be known that this centre is there to serve industry in terms of technical inquiries and then learning from experience what kind of information is most commonly needed, how quickly it is wanted and in what form it is wanted. Once we have validated all of those parameters, then we can plan this nationwide system. It would be very easy to go overboard with a very sophisticated system, using computer networks and so on, and then find that not enough use is being made of it to warrant the expense.

The Chairman: I suggest we now go to page 26 and consider paragraphs 2.2(d) and (e) and (f), together with paragraph 2.7 at page 45. All of these sections of the brief deal, in my view, with decision-making regarding budgets, planning and monitoring and reviews of the goals and activities of NRC.

I am particularly interested in asking a few brief questions with respect to the decision-making process which has been developed by NRC over the years. I believe, Dr. Schneider, that the first time you were before us you mentioned that the minister, because of the practical nature of the council, did not play a very important role in that decision-making process. Am I correct in inferring this?

Dr. Schneider: Well, I would not agree that it is not an important role. It is a very important role, because, essentially, he is our contact with, if you like, government decision-making in cabinet.

Senator Greene: With the money bags.

Dr. Schneider: That, too. Essentially, the difference between the National Research Council and, let us say, a department of government, is that we do have an external

council, which was set up deliberately by Parliament to supervise and direct the work of the council, so that the minister would then not be required to give day-to-day direction. Since this is a highly technical field, and also, I suppose, the intent was deliberately to give it a degree of autonomy, one reason for which, I imagine, is so that not all of the emphasis would be on short-term or immediate problems, but so that the council would be free to look down the road and concern itself also with longer term needs.

The Chairman: You mention in your brief your relationship with Treasury Board. Would it be true to say that the role of Treasury Board in this decision-making process is more or less like that of a pair of scissors, in terms of which they cut your programs without too much scrutiny?

Dr. Schneider: I have to say, first of all, that the last few years have indeed been very, very difficult, because we do spend a lot of time putting programs together that we think have very high priority, and that have been discussed very extensively with other departments, industry, and so on, and which do in fact fit in with the government's announced priorities. You can well imagine, therefore, that it is a very great frustration when we get to the hour of decision, and all these nice plans get lopped off. We understand, of course, that the economy at the present time is in a difficult position, and that we have to accept this sort of thing; but nevertheless, it is not easy.

The Chairman: What about your relationship with MOSST? We have been told that MOSST has a kind of over-all advisory role in looking after the so-called science budget of the government. Is the ministry's advice sought by you, or by Treasury Board, on the size and distribution of your own budget?

Dr. Schneider: Well, we consult very closely with MOSST, and certainly, as far as our budgets are concerned and particularly the university grants budgets, there has been very close consultation; but it seems that even in this area MOSST has had no more success with Treasury Board than we have.

The Chairman: But you submit your annual budget for advice to MOSST before it is presented to Treasury Board?

Dr. Schneider: Yes, simultaneously. Our program forecasts are sent to both agencies.

The Chairman: And what about your own council? I recall vaguely that we were told a few years ago that your council devoted a relatively minor proportion of its time to consideration of your own in-house R&D activities. I remember a figure of between 15 and 20 per cent being mentioned, and the statement being made that most of the activities of the board were devoted to grants and other operations. Is this still true? Or was it true at that time?

Dr. Schneider: It has never been true as long as I have been President, Mr. Chairman. I do not know where the fairy tale came from.

The Chairman: I think it came from one of your letters.

Dr. Schneider: Not from one of my letters. The thing is that there are two levels, really, of dealing with our business. We do have a number of committees, and, as you know, on grants and scholarships we have a standing subcommittee of council that deals with all the nuts and bolts, as it were, of that program. They make all the

regulations and set up the review committees, and so on. This committee will also bring policy questions to council. Council concerns itself with policy questions and will not go into all the details. We have the same thing for the laboratory program, and for the scientific and technical information program, in connection with which we have an advisory board for scientific and technical information. These people put together all the details, and in effect direct a program within the policy laid down by the council. If policy issues arise, they will bring these to council, and so it is a pretty balanced effort, I would say, Mr. Chairman, directed towards dealing with all the programs that we have, including industrial and industrial research assistance programs.

The Chairman: I remember that when you became president of NRC you set up a program planning and analysis group. I understand that this group does not exist any more. Is this because the directors refused to be planned or analyzed? Or is there any other reason why this group has been disbanded?

Dr. Schneider: I think this is a case of evolving. We tried something. We wanted to develop a better means of doing our forward planning, of reviewing our programs, and also of setting our priorities, and we felt that perhaps this should be done by people who were not preoccupied with day-to-day operations. We felt we could have a group over on the side who did not have these preoccupations, who could do a lot of deep thinking and produce plans appropriate for the consideration of council.

Our experience with this was that it was very difficult for these people, really, to spend sufficient time with the people who were doing the work, and in fact, they really needed to have a much closer liaison than in fact developed. This was really nobody's fault. This is the way the researcher operates, and this is the way I suspect any organization operates. The people who are doing line management, of course, have to be involved as well in the forward planning and reviewing of programs that are going on, and so we came to the conclusion that really, first of all, to develop better planning, and on-going program review, you have to involve the very people who are going to do the implementation. If you do not involve them right from the start, and they make a very strong personal commitment, it becomes much more difficult to sell a new program to them than if they were involved with its planning and development right from the very beginning. I think this is a very important principle, and it probably has pretty wide application.

We came to the conclusion as a result that a much better way was to make sure that everybody got involved. It becomes part of operations, particularly the technical planning, when you get to the program and project level, and then, of course, also, at the strategic planning level, which involves largely our council and internal management committee, and the people we ask to help us.

In many cases we do this by putting together a task group which will involve the people who are close to the subject area, and assign some additional staff people to take the first run at it and make an analysis, and then provide a policy report which can be considered by council and dealt with in that way.

Senator Thompson: Does the converse take place? Do the people who get involved right from the start have a commitment to the project in analyzing it and deciding that you are going to stop it? If it has been analyzed by the

people who are involved in it, is it very difficult for them to come to that decision?

Dr. Schneider: I think that if you are going to plan a new project, unless there are some people who are very well informed in it from the beginning, and as a result of their information and the study they have done are convinced it is an excellent project, they are naturally going to help promote it, and I think, in many cases, you need this. Of course, they also understand that if it is a new program it has to go through the whole decision-making process, that is, approval and funding. If it is not approved, we have to accept that. But I think it is still the best way to arrive at and develop the kind of project that is going to be favourably considered for funding.

Senator Thompson: I understood that this group were doing review and analysis as well as planning.

Dr. Schneider: Yes. This was a group that, as I say, were off to the side, and they were doing nothing else but looking at and planning programs. Now we feel that this is everybody's business, both the planning and reviewing of what we are doing, and it has to involve the people who are doing the work.

The Chairman: But there is a great danger—and this is not a question, just a comment—that the “planees” could become the planners.

Senator Godfrey: I think Winston Churchill would agree with you, because during the war he felt there should be a planning committee of active ministers.

Dr. Schneider: That is provided the active ministers have enough time. It is always a fight for the time, but provided they recognize the importance, then they will find the time.

Senator Grosart: Apart from the totality of the budget available to you, how independent in reality are the science spending decisions of NRC? You say somewhere, for example, that all your programs are subject to review by Treasury Board.

Dr. Schneider: Well, there are two phases to this. One, of course, is when we come in with our program forecast, and this is scrutinized in great detail. The second stage comes after that.

Senator Grosart: Who scrutinizes the first step?

Dr. Schneider: The Treasury Board staff analyzes it and MOSST as well. The second stage comes after our estimates have been approved by Parliament and we have our separate votes. Within, let us say, the university grants and scholarships vote, since these are paid out as grants, the council is left a fair degree of latitude with respect to allocations to a particular discipline or to a particular project. There are certain decisions that have to be made and have to be approved by Treasury Board, such as the amount we spend on scholarships and the amount we spend on grants.

Senator Hicks: But they would only determine the outside amount on scholarships. That would be the limit?

Dr. Schneider: That is right. But in our operating vote, as far as the allocations to our various laboratory divisions are concerned, we have to present the proposed allocations to Treasury Board, but once our vote is approved, and they have approved the general program,

this also is left to our discretion. When it comes to certain larger expenditures, we have to get prior approval from Treasury Board.

Mr. Cumming: As far as specific contracts are concerned, Mr. Chairman, capital expenditure on a contract in excess of \$250,000 would require specific Treasury Board approval.

Dr. Schneider: Then during the course of the year if we have a proposal for a new program, and even though we can find some of the funds or have some of the funds in this year's budget, we would have to get a specific program approval from Treasury Board because it means committing funds for subsequent years.

Senator Grosart: But, Dr. Schneider, apart from the totality of the budget, which I can understand is a Treasury Board function, who is equipped in the Treasury Board Secretariat to analyze your programs, vote by vote or in any way, and say that their knowledge or their judgment is superior to that of NRC?

Dr. Schneider: Do I have to answer that question?

Senator Grosart: Well, it is a fundamental question because we have been dealing with national science policy, and this is almost the nub of it. Do we go back to Treasury Board making science policy decisions? I know it is possibly a difficult question, but I think it should be asked.

Dr. Schneider: Well, to be fair, I think it is not that they try to make decisions on individual projects themselves. They do of course get outside advice and there are many places they can get it including MOSST and other departments, but it is Treasury Board's business, and they take this very seriously, to see that these programs are co-ordinated and that there is no duplication as between one department and another.

Senator Grosart: But, surely, that is MOSST's function and not Treasury Board's?

Dr. Schneider: I would not dispute that, but I think that when it comes to talking about the technical merits of a program, then that is a different area, and I think that kind of evaluation should be made by people who are knowledgeable in the area. It may be that we do not have the money for such a program even though it is a high-priority program, but I think that at least the technical merits can be established.

Senator Grosart: I would like to pursue that question, but I won't.

The Chairman: We are reaching now page 28 of the brief, one of the most wearing parts of the brief, and I think we should spend some time on these few paragraphs.

Senator Neiman: May I begin by asking Dr. Schneider what he feels can be done to recruit more young scientists and engineers, not only into NRC but into science generally? Is it a general problem? What do you think you should be doing, and what do you think the government should be doing?

Dr. Schneider: I think perhaps the problem would not have arisen if we had had a fairly smooth progression. But what happened is this. In the 1950s or early 1960s we had rather a rapid growth, and this was not only in most

government laboratories but also in the universities. Then when we approached the 1970s we had austerity in 1968 and we were required to reduce our staff, and we have been reducing it ever since. I guess it has levelled off now, but the result was that we have done very little recruiting since 1969 and so our age distribution is getting rather askew. In the normal course of events, if you do reach a fairly steady state, when you have people retiring at one end there is a certain amount of turnover and you can keep bringing in young people. But unless this can be done at a rate sufficient to keep ideally the peak distribution or the average age somewhere in the 30s, then I think to correct this now we would have to have new resources. We cannot do it "plateaued" as we are, in effect. Because of inflation we are really cutting back each year.

Senator Neiman: Is it simply a lack of resources that is causing young people to turn away from science, and causing them to emigrate to the United States, or is it lack of opportunity?

Dr. Schneider: At this moment it is lack of opportunity. I should correct this first of all. They are not turning away from science. There are many very good young people who would like to make a career in science, and it is unfortunate at this very time when both the university sector and the government sector are not hiring at all. We had great hopes that there would be more opportunities in industry, and that has not developed either. So it is rather a sad period for our young people. Nevertheless, there are many young people who are tremendously interested in science and want to pursue it, and I hope that things won't always be this way—that pretty soon we can pull out of this. But at the moment it is rather a bleak picture.

Senator Bourget: You mention in your brief that you have reached the number of 600 researchers. Are they all permanent employees, or are they employed for a certain length of time according to contracts which they may have with NRC?

Dr. Schneider: The majority would be ongoing employees. I should mention that we used to have a program of post-doctorate fellowships which were tenable up to two years, being renewable at the end of the first year for a second year. The intent of this was to bring in young people and new blood and NRC was a good place for them to come to do research in order to advance their careers. After leaving they were recruited either by universities or industries. Some came from abroad and returned to their own countries. Two years ago we changed this program, largely because for one reason the engineering divisions felt that one or two years was too short in the type of projects that they had. Also, the engineering divisions were making less use of these post-doctorate fellowships. One reason, of course, is that the post-doctorate training is not as common in the engineering disciplines as it is in chemistry, physics and biology. However, we felt this was very important in the engineering disciplines, because these people would go to industry and, I believe, having had the experience at NRC would become very valuable to the firms and we wanted to encourage this. So we have changed the former post-doctorate fellowship program into one we call research associates. Instead of a stipend which would be approximately \$10,000, we actually pay them at going staff rates. The initial appointment is for a year, but can be renewed up to five years.

The Chairman: I am sorry, Dr. Schneider; I think this can be covered in other areas of your brief. On page 28

you really concentrate on your more or less permanent staff, and we can return to these other programs which are more or less temporary. Senator Bourget's question at the beginning was directly related to this.

Senator Bourget: Yes.

Senator Thompson: You must be concerned, Dr. Schneider, because you mentioned at an earlier meeting that the innovative period for scientists is only until he is 33, or something, and then he is over the hill.

Dr. Schneider: I don't think a scientist is ever over the hill. What he might perhaps lack in daring when he gets into his later years he makes up for in his broad experience. As a scientist develops he becomes interested in more and more things and broadens his interests and background. I think a mature scientist is a tremendously valuable person in terms of the expertise and the wealth of knowledge he carries around in his head. I think also as consultants and particularly in industry those individuals are tremendously valuable.

Senator Thompson: Could I put it another way, Dr. Schneider: In view of the normal advances in science during the last two decades, for a person to be really up to date would require almost coming directly out in a new discipline.

Dr. Schneider: Certainly new developments do change things rather rapidly and, for example, today the new graduates coming out of universities are tremendously computer-oriented, where the graduates 20 years ago would not have had this background. Of course, sometimes this is overdone and one turns to the computer rather than sitting down and thinking a problem out.

Senator Grosart: It applies to economists also.

The Chairman: It seems to me, though, that the situation you are describing is rather worrying. You say you have to keep these people and you cannot increase the number. As a result of this, the age distribution is increasing, which you think is unwise or unsound. Your equipment is becoming more and more obsolete. So my impression, at least, is that you are on the verge of running a kind of social insurance system because of the immobility of your older people, and that might kill, really, the innovative capacity of NRC.

Dr. Schneider: There is some turnover and, of course, there are some retirements. Some of these we can replace and do so by new recruits at a young age. However, the big problem is really that at the present time, with the restrictions on manpower, it is just not possible to get any new man-years in order to take on any more new recruits. If this continues much longer, in my opinion the situation will become very serious.

The Chairman: And you think it is almost impossible to move some of your older people to other jobs?

Dr. Schneider: We do, but unless they move right out of the system it does not really solve anything, because we have a fixed number of man-years. In the last few years we have not gotten any new man-years, so we cannot bring in new people. The only recruiting we can do is for replacements.

Senator Grosart: Mr. Chairman, this would seem to raise the whole question of conceptual economy. Is your concept too big in view of the constant or deteriorating

resources available in real dollars? Is the question: Are you trying to do too much? Which then, of course, leads to the question: What programs should you be getting rid of? Would it not be better to get rid of some programs, therefore some staff, therefore some equipment, so that you could economize in your whole concept and have more younger and resourceful people and better equipment available for what you are doing? It is a hard way to look at it and I am not saying it is the ideal way, but assuming, and I think we can assume, that your financial resources will not improve rapidly in the next few years, is that not the case?

Dr. Schneider: Having had eight or nine years of restraint, we have been trimming, trimming and trimming and everything that is left, if we suggest closing anything down there are howls, as these are all considered to be very essential and important programs. Yet there are needs to start new programs, such as energy and others which are very important at the present time and will be of ongoing concern. We need new resources. We have been constantly shifting resources toward these newer programs, but only so many can be shifted, otherwise the other programs will be affected. Also we have to look for special expertise, which we have to obtain from outside, which means recruiting new personnel, which means new man-years.

Senator Grosart: Is it better to carry on an existing project, using out of date equipment and inadequate personnel, than terminate the program?

Dr. Schneider: I agree that once it gets to the point that it is no longer effective and paying off and productive, you are quite right, we would be better to close it down. However, in ongoing programs there are more and more demands being made on us and it is difficult for us to respond. We can only take on so much.

Senator Grosart: What is the prospect, then?

Dr. Schneider: I had hoped that this year we would start turning the corner, but the noises I hear so far indicate that the prospects for next year are not that good. However, we cannot go on very long in this vein. At some point we have to turn the corner. Hopefully, the economy will pick up and we will control inflation somewhat more and be in a position to do something about this. However, I think we are really running down badly in this country as far as science is concerned.

Senator Grosart: Over this period of restraint which you suggest may have been going on and off since 1968, what would be the percentage erosion of your financial resources in real dollars?

Dr. Schneider: Perhaps the best way I can answer that is to show you a curve which I have with me. This curve goes back to 1968-69, and we have taken constant dollars from 1968-69. These are all relative to 100 for that year. The green line is GNP and the red line is the federal government voted expenditures. In other words, it does not include the statutory expenditures. The magenta curve is the total R&D expenditures by the federal government. That does not include "related scientific activities" expenditures, but what I call R&D. Curve "C" is the federal government expenditures in support of industrial R&D.

Senator Grosart: I wish you would send this to Mr. Drury.

Dr. Schneider: I have. Line "E" is the university grants and scholarships program of NRC. It was holding its own and then in about 1971-72 took a dive. It went up again, but then this year it is frozen. Finally, line "F" is the NRC laboratories. We have been going down since 1968-69. In terms of staff we have not even got back to where we were in total staff in 1968-69.

Senator Bell: And you do have to use more of your staff in an administrative capacity on top of that?

Dr. Schneider: Partly because we are doing more contract management and more contracting out and, secondly, with all of the extra paperwork we are now required to do by central agencies, and this keeps mounting and mounting, we require more clerical help to deal with that.

Senator Hicks: Dr. Schneider, can you compare Canada's research and development efforts with those of other industrialized countries?

Dr. Schneider: I can. I would caution, however, that that kind of exercise has pitfalls, too. There is no reason why every country should be the same; every country has its own different needs. Particularly, it should be pointed out that in some countries, such as the United States, large sums of money are spent on defence and space research programs. When we talk about the division between the industry sector, the government sector and the university sector, this comes into the picture. As a matter of fact, in the United States, if you were to subtract out the funds being spent on defence and space in industry, you would find that that is where most of the money to support industry goes. So-called civilian science is mostly done in-house and only a small amount of development is contracted out to industry. It is something like 72 per cent which is done in-house. Of course, with ERDA, with the new energy programs, this will change somewhat because there will be a large injection of new funds. We all know that in the industrial sector in Canada we are underinvesting in research and development, but at the same time that does not mean that in the government sector or in the university sector we are spending more than other countries. In fact, if you make the proper comparisons, we are spending less than most other countries. But if you take it in relative percentages, then the industry sector shows up glaringly. This is largely because industry itself is not investing as much in research and development as it does in other countries. We know the reason for that, of course.

Senator Hicks: I wonder if it is valid to refer to figures in that way. For example, in one of the science magazines recently it was pointed out that Canada's share of the gross national product was something like 0.8 per cent, whereas for a country like France it is over 2 per cent. Is that valid or are there so many qualifications to those figures that they lose their validity?

Dr. Schneider: Not only might they lose their validity, but in the first place the rationale is that you do not spend money on research and development unless you have a good reason for doing so. Our needs are different from other countries. We are largely a resource based country. You cannot compare us, let us say, with Germany or the United States or Japan. We have invested relatively more in developing our natural resources and resource management, and much of that has been done in government rather than in industry.

The Chairman: It seems to me, though, that if you go on like this and have to get older and older people working

for you with obsolete equipment, you will end up doing research and development just to keep those people there because of their tenure.

Senator Hicks: There is another point related to your observations about subtracting the expenditures on the space program and defence research in the United States; it is not automatically proper to subtract all of those expenditures, because an enormous amount of spin-off in discoveries and inventions have occurred which, in fact, are useful beyond the limits of the space program or the defence program.

Dr. Schneider: Along that line, I heard it suggested with respect to the Olympic Games that perhaps the construction for the Olympic Games was not all wasted because there would surely be a spin-off which will create a lot of new employment.

Senator Hicks: I don't like that analogy.

Senator Cameron: Dr. Schneider, what is the situation with respect to foreign students? I am thinking of foreign students who come here on a two or three-year scholarship ostensibly to return to their home countries. I have the impression, which may be quite incorrect, that many of them do not return because they find the conditions and opportunities here so much more favourable that they go to great lengths to avoid going back. Is that an oversimplification on my part? Am I being unfair to them?

Dr. Schneider: The situation is not quite as bad as it was a few years ago. The picture is changing partly because of a change in the immigration laws. Perhaps Dr. Gingras would like to respond to that.

Dr. B. A. Gingras, vice-président, university grants and scholarships, National Research Council of Canada: Yes, Mr. Chairman. This is still a problem, but not as important as it was eight to nine years ago when students could come from India or other countries and become landed immigrants. They would come here for studies and then they would not wish to go back to their home countries after completing their baccalauréat, their masters, or their PhDs. At one stage, the National Research Council was quite concerned about the number of these foreign students in our universities. In certain disciplines it was perhaps more serious than in others. We have established a rule whereby NRC moneys going to university researchers cannot be used to support foreign students. The rule is still in existence today. This policy was started in 1969; however, in the last year, with the new regulations pertaining to immigration, it seems that foreign students can no longer come here and become landed immigrants; they have to come on student visas and then go back home. They can then apply for landed immigrant status, after the fact. The feeling of the university community at this time is that the situation will correct itself in a relatively short time.

Senator Cameron: Those student visas are for how long?

Dr. Schneider: They are for the length of the course.

Dr. Gingras: Yes. It depends on the circumstances. Most of these students come for graduate work, so it would be for three or four years, normally.

Senator Grosart: I wonder if I could ask Dr. Schneider, again, a question in relation to this problem referred to in

section 2.2(g) on pages 28 and 29. Have you made a man-hour study, by activity, with particular relation to laboratory time, administration time, and external time? For example, I notice, over on page 139 to page 147 you have a list of the time you spend with other organizations. I added this up to, I think, some 500 organizations that you serve, and to take an odd example, such as the International Electro-Technical Commission, you provide five chairmen and 13 members of committees. In total you provide these man-hours to something like 500 committees. Have you analyzed this, so as to be able to ask yourselves if this makes sense, or whether you should be curtailing your activities here?

Dr. Schneider: With regard to many of the international bodies, of course, they are highly selective. Often, for Canada to have a member on some of these commissions is considered to be very important, and we are usually encouraged to participate by the Department of External Affairs. As far as the Canadian organizations are concerned, we feel that it is part of the role of NRC to support these technical activities, whether it be a standards committee or some other technical organization which contributes to them.

Senator Grosart: I am not questioning the value of these activities. That was just my original illustration. Have you made a man-hours study? That is my question.

Dr. Schneider: Some of the divisions have done this in quite some detail.

Mr. Cumming: It certainly has not been done in a comprehensive way so as to cover the entire laboratory operation. I really could not assign a figure to it.

Senator Grosart: It might point the way to a solution of this problem if you were to decide where you are spending your man-hours, and if you were to take these various committees and calculate the travel time involved, and so on. I would say that there must be hundreds of thousands of man-hours involved here.

Dr. Schneider: A lot of the travelling is done during evenings and on weekends.

Senator Grosart: I am not criticizing, of course.

Dr. Schneider: I would like to point out one particular thing which we think is very important, and which our staff considers to be a part of their role, and that is as consultants for industry, or people in other sectors, who come to us with problems. We think that taking up to 20 per cent of a man's time with these matters, and in fact, having these outside contacts, is good for them. It keeps them in contact with the real world.

Senator Grosart: I am not asking for justification, and I come back to my original point: are you satisfied that the totality of man-hours spent on this, as against laboratories and the problems you mentioned of people who might better be spending their time in laboratories but who are now section heads or directors, is justified? Have you studied this matter to the extent that you can say, "Well, perhaps this is where the problem is"?

Dr. Schneider: We have not asked each person to account for the use of his time, but as I say, we do encourage the spending of a certain amount of time on these outside activities. They are directly related to the work of the individual involved, and make use of his

experience and expertise. However, some of the people, and particularly the younger people, would be doing less of this. The people who are more experienced, and older, would probably do more, so that the load does not fall equally.

Senator Grosart: It would be interesting to see a comparison of man-hour use back to, say, 1968, from today. It might give some factual basis to the problem.

The Chairman: In constant hours.

Senator Thompson: Mr. Chairman, I was going to ask about another sort of study. I am referring to Senator Hicks' question about spin-off. You yourself have talked about the spin-off that was taking place in small industries in the Ottawa-Hull area. We were going to have an embryonic development on the lines of the much quoted Route 128 in the Boston area, and this would come about in our area in connection with the Defence Research Board and Atomic Energy of Canada. I was wondering whether NRC or any other government agency had made a thorough study of the phenomenon to which you referred.

Dr. Schneider: Yes. I would not say we have made a thorough study, but some years ago we did look at the possibility of creating a research park right next to us. It was to be both a research park and a light industry park in the high technology field. We pursued it, we studied similar setups elsewhere, and had discussions with the National Capital Commission who drew up some plans for us. We were very interested in the project, but in the end the plan was not approved.

I do not think the Route 128 model is valid today, but certainly I think it is still valid if you have some major research laboratories and other factors in the community that are favourable. I think this can help to generate this kind of spin-off.

Senator Thompson: I am thinking of Sheridan Park, in Ontario.

Senator Grosart: It is not a very good example.

Dr. Schneider: No, that was not a very successful project.

Senator Thompson: Are you still going to pursue it?

Dr. Schneider: No.

The Chairman: I have one question which is related to biology, and which is referred to in general terms on page 52. I have received, as chairman of this committee, as I have already told you, Dr. Schneider, quite a number of letters from biologists. The points made by these individuals are, first, that they do not get their fair share of money from NRC, and are discriminated against in comparison with, say, nuclear physicists. The second point is that they believe too much biological research is conducted within government laboratories, including those of NRC. The third point is that they are of the opinion that the government favours its own laboratories, while denying funds to university laboratories. Finally, they believe that basic biological research is best done in university laboratories and not in government laboratories.

Senator Grosart: Did you get the same letters from all the other disciplines complaining that too much money is being spent on biology?

The Chairman: It was a conspiracy, perhaps!

Dr. Schneider: I should say, first of all, Mr. Chairman, that at the present time all the university disciplines that we support are under-funded. I think that case has been made.

As far as the second point is concerned, the comparison between the biological research being done intramurally, as against that being done by the universities, I can only speak for NRC, to say that NRC has three divisions that are doing work in biology, though not exclusively. These are in the prairie region laboratory, which is concentrating on plant science, and I think you know about that one, our own biology division here in Ottawa, and the Atlantic regional laboratory, three-quarters of the work of which is in the biology area.

As far as NRC's intramural research in biology is concerned, I would like to refer you to a report of the Science Council of Canada, which set up a committee to study precisely this question. Perhaps I should read their recommendations.

In the opinion of the Science Council the biological laboratories of NRC can best contribute to the national effort in science and technology by continuing to develop their interest along the lines that now seem to be apparent. They should be project rather than discipline oriented, and they should increasingly apply the inter-disciplinary approach to the solution of problems that appear to be ripe for vigorous attack, but are not within the missions of other federal departments.

It is this ability to bring together different disciplines on important, significant projects that we think is the main advantage we have as against university laboratories. So the Science Council recommends "that the intramural biological research of NRC continue to develop along present lines emphasizing inter-disciplinary applied research in aid of fresh missions, and that NRC encourage increased collaboration among its biologists and those in other government agencies, the universities and industry."

We have been co-operating in a number of areas where in fact, some co-operative projects in university research are funded through grants and scholarships programs and some of the NRC scientists working closely with them. There are also quite a number of contracts from our biology division going out to universities in the area of research required for the associate committee on scientific criteria of environmental quality which NRC is responsible for. There are gaps in research that are urgently needed to be filled and contracts are let and most of them go to university researchers to obtain this data. So we are co-operating very closely. And I think it is the general view of the university researchers in biology that NRC is a valuable asset which complements their research and that we are not in direct competition.

As far as the support of biologists is concerned vis-a-vis other disciplines, perhaps I might ask Dr. Gingras to give you more detailed information on this point.

Dr. Gingras: As Dr. Schneider said, most of the disciplines supported in universities by the council are suffering in terms of dollars at this time, as you well know. However, in spite of frozen budgets this year, the Council has made a conscious decision to favour some disciplines versus others, and the biological disciplines as a whole have been favoured, and so have the engineering disciplines at the expense of physics, which was mentioned in this letter, and chemistry and a few others. This is for a set of grants to individual biologists. There was an increase in

the number of biologists in universities but in addition to taking care of the increase there was a conscious move towards better support of biological sciences. Perhaps another element here that one should mention is that the areas of major grants which we call major negotiated development grants where biology has fared very well in this sort of competition. There have been many major biological programs where a special million dollars a year was put into biological research. One was terminated two years ago. It was called the International Biological Program. It was a ten-year program. So naturally they are not as well treated as they would like to be, but they are on the increase in terms of NRC grants to them. It has gone up from 16 per cent in 1964 to now where it is 24 per cent. That is going for biological sciences.

The Chairman: Thank you very much. This will help me in answering all those letters.

Senator Godfrey: Would they be writing to you in the same vein?

Dr. Schneider: Oh, yes, and not just the biologists.

Senator Grosart: Then going to page 91, which deals with the transfer of World S. and T. Information and data, would you say, leaving aside the foreign subsidiary situation in the industrial sector, that Canada should be providing more new knowledge to world science or receiving more, in comparison to other countries?

Dr. Schneider: Well, I think at the present time there is no doubt that we are receiving a lot more than we are contributing. I suppose, being a small country, that is not surprising. It is very difficult to say how much we should be contributing; I suppose the simple answer is as much as we can afford. I suppose it is the same as the question, "How much should we contribute to the arts?" And you get the same answer, "As much as we can afford."

Senator Grosart: No, it is not quite the same question. Because I am thinking of the old question: Should we be specializing more in those areas of science activities where our needs are greater than those of other countries and where we can therefore expect less input from the world store as compared to other areas of science activities?

Dr. Schneider: I think there is no question about that. I thought perhaps you meant from your first comment curiosity-oriented science. I think there is no question that in these areas if we don't do it, nobody is going to do it for us. We really have to put our major effort into those areas which are particularly important to Canada. Because there we do not have this world-wide pool to draw on. That of course does not cover very large fields like health, for example. What should we be spending on medical research? A great deal of that is being done elsewhere. But when you come to applied research and technology, you have quite a different question. In these areas where we have a particular need in Canada, my concern is that we do not go far enough and develop it to the point where we become world experts and find markets abroad where people have similar needs. This is where I think we do not specialize enough.

Senator Grosart: Would this apply all the way through the whole science activity spectrum, from research through to development and innovation?

Dr. Schneider: It could, but I don't think you could limit it to that because I think the areas that are particularly

important to Canada and where we have special advantages or special conditions, like climate, are certainly ones that are obvious. But if you go to something like manufacturing industries, then it is not quite so obvious. These involve a number of consumer needs that many other countries have and even here we have to be selective and build on our strengths. We have to see where we have an opportunity and where we can find a niche. But once we have found it, we have to push and try to excel. If we try to cover the waterfront, then I do not think we will get anywhere. And yet, I think we have a lot of strengths to build on and I am a bit frustrated myself that we have not gone further in this direction in Canada.

Senator Grosart: Would this apply to R&D and teaching efforts in universities? It is sometimes called the Olympic Race Syndrome—that you have to be in every race. Are we trying to do too much of that?

Dr. Schneider: I think that when you get into the educational field it is not quite so simple. How many fields can we afford to opt out of? I think those decisions are simpler when we are deciding what type of research we should do.

Senator Thompson: Following from that, Mr. Chairman, I am rather curious about the process by which NRC, as an institution, arrives at these areas which are of long-term benefit to Canada.

Dr. Schneider: You are asking how we arrive at these decisions?

Senator Thompson: Yes.

Dr. Schneider: I think those kinds of areas are usually pretty obvious. First of all, the question is: Is research going to help solve that problem? Secondly, if it is, then what particular research should we be doing? Energy is a good example of this, and food research is certainly another good example. There may be other areas where research is not necessarily the answer. I think that when we talk about some of our industrial problems and we keep saying we have a lack of innovation, I wonder if the problem there is really research. It is perhaps a combination of things.

Senator Thompson: As I recall, the Science Council put out a number of booklets telling us what were going to be the priorities for transportation and a number of other things.

Senator Grosart: Report No. 4.

Senator Thompson: Were those translated into research by you? What happened? Were they just academic pursuits or were they the policy you have followed?

Dr. Schneider: I think it is a matter of degree. I think the concept of what the Science Council called its major program is not necessarily a bad concept if the particular area lends itself. Perhaps they formulated that in too restrictive a way. I believe there are a lot of areas where larger national projects would be highly beneficial, and where in order to get anywhere we have to combine the resources we have in the universities, industry and government. I think we are just beginning to do this. We have been trying to promote this for some years and it is coming slowly. I do not think it necessarily has to be on the kind of scale the Science Council have been talking about. There are many areas that I think could benefit from something a bit more modest.

Also, the suggestions that were first made by the Science Council were not, I think, necessarily ones that were the most favourable; they mentioned water resources and space research. I think we could easily come up with another list which perhaps could pay off more immediately, and also ones that obviously will be important in the long term. I think we are just learning to do this, at least at the federal government level, trying to bring the various departments together, because in almost every major field you find a number of departments have an interest; industry has an interest, research and universities have an interest, the provinces have an interest. It is very difficult.

We have gone through this with the energy program, and I for one was getting a bit frustrated; it was taking so long, but eventually it did come together. I think the processes and the mechanism they have used there can be improved, and I hope with the next one, which has been started on food R&D, we can learn from previous experience and do a better job.

I think this is the direction we must go if we are to achieve something significant. We must have this integrated program and mobilize resources in all sectors. For that reason, I would be sorry if the academic researchers felt that the university sector would be one isolated place, industry another and government somewhere else. We have to work together, and if with the resources we have we are to achieve these kinds of goals we must integrate our efforts and have our objectives fairly clear.

One of the impediments here, however, is that if you are going to do R&D in these major areas, in setting goals you have to know what is the country's policy, what is the government's policy objectives in this area. This has hampered us somewhat in our energy program. There have been a number of policy papers on energy. These have been attempts to deal more with the short term, but when talking about energy you need to be thinking beyond the year 2000. This means longer term, and I do not think we have really yet come to grips with this. Of course, there are immediate and pressing problems in the shorter term.

It is the same thing with food policy. This touches on a wide variety of problems. There is a policy paper being developed. Again this should go ahead of the new R&D programs that we are going to develop, which will be compatible with the overall policy in that sector.

Senator Bell: I should like to follow that up, because I have a long list right here, and I am so glad you mentioned this. I am referring to co-ordination. I was thinking of the food technology section of your biology division, and how you are going to integrate that with food and drugs, health and welfare, with medical research, with perhaps the packaging and labelling regulations. There are so many aspects that seem to me to be totally unco-ordinated. I do not believe there is any western country that co-ordinates these aspects of food technology and production.

Dr. Schneider: There are all these interests, and very often these are in different departments. This is a problem, and this is why I suspect it takes so long to get all these things together, get them sorted out and have agreement on the main policy objectives and, most important, on the priorities. We are just learning how to do this on this larger scale. There are some, of course, that are involved with regulatory aspects, and I think these are specific objectives. If you are talking about R&D to pro-

duce new sources of energy or to produce new types of food—

Senator Bell: It is energy.

Dr. Schneider: Those you can identify and those are things that you have to concern yourself with first. Further down the line you have to worry about the environment, the social and regulatory aspects, the consumer aspects and so on. The R&D has to go ahead first, and here you will focus on the things that will produce new food resources or new energy resources. Then as you go along to develop some feasible technologies you examine the health aspects also, and so on.

Senator Bell: Are these not mutually exclusive?

Dr. Schneider: No, but there is no use worrying about health aspects initially if you are going to do R&D about some new energy source and you do not know what that source will be, or thinking about the possibility of producing, say, food from cellulose, if you do not yet know what that food will be until you have produced some products, after which you examine the health aspect.

Senator Grosart: In this confusion of tongues have we altogether forgotten the concept of centres of excellence in Canada?

Dr. Schneider: I hope not. This is something that concerns me a great deal. I hope the present restraint does not last too long, because I think we are in great danger of seeing some of these centres of excellence either falling apart or becoming centres of mediocrity.

Senator Grosart: Are there any areas of R&D or science activity where you would say Canada would, on a comparative basis, be regarded as a country which was a centre of excellence in that discipline?

Dr. Schneider: Perhaps to talk about a discipline is a bit broad. In some branches of disciplines there is no question. We still have some very good centres at NRC and in

some of the universities. I think some of our university research efforts now are of a very high standard and can hold their own with the best in the world.

Senator Grosart: I was speaking not of individuals but of Canada as a country. We speak of certain countries, such as the United States being the centre of excellence in space and so on. Have we reached the point where we can say there is anything in which Canada leads the world in R&D? I do not mean in volume but in excellence.

Dr. Schneider: In excellence I would point out the Prairie Regional Laboratory, the National Aeronautical Establishment and particular units in Biology, Chemistry and Physics laboratories at NRC, which are well known across the country. In spectroscopy there is Dr. Herzberg's group and a number of other groups in this field. Certainly they have been outstanding world wide. On the industrial side, I suppose one should mention pulp and paper and the electrical power industry, which is well known, particularly in high voltage transmission. There are areas like this that have been pioneered in Canada. There are a number one could identify but they are not on a vast scale.

Senator Thompson: Are you concerned that some of these areas, because of lack of resources will in some way not attain the full potential that Canada could?

Dr. Schneider: I would say, certainly if our present restraints continue very much longer we will be in real danger. The centres of excellence we have will not be able to maintain their position.

The Chairman: On this very pessimistic note, we might as well conclude. Thank you very much, Dr. Schneider. I wish on behalf of the committee to thank your colleagues also. Regarding your invitation to visit you, I am afraid we will have to postpone it until next fall, but you may rest assured that we will pick it up one of these days.

Dr. Schneider: We will be happy to welcome you whenever you can find the time to visit us. Thank you.

The committee adjourned.

APPENDIX "24"NATIONAL RESEARCH COUNCIL OF CANADAREVENUE 1975-76

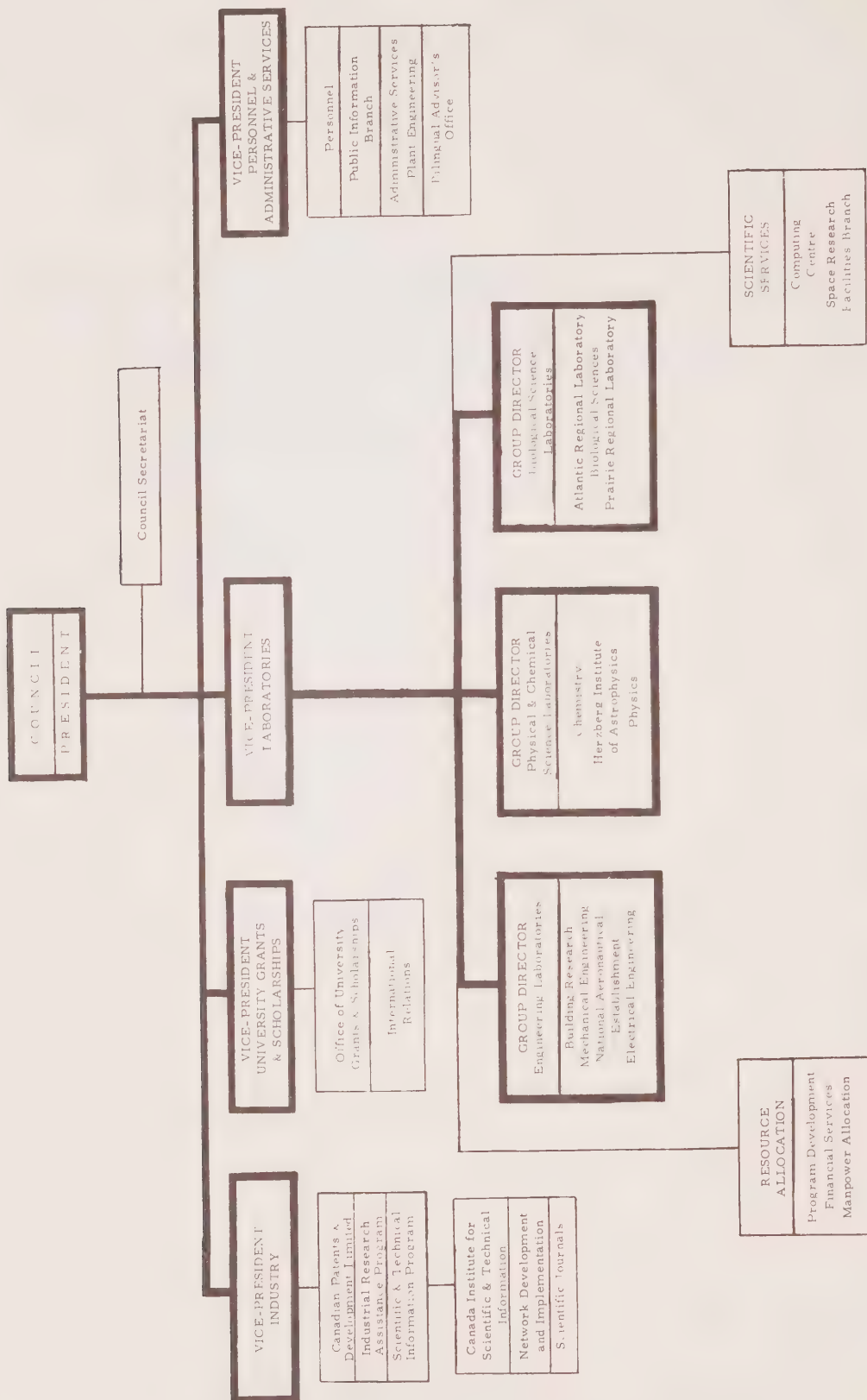
Laboratory Services, including Churchill Research Range	\$1,686,000
Publications, including Research Journals & National Building Code	856,000
Scientific & Technical Information Services	479,000
	<u>\$3,021,000</u>

FINANCIAL ENCUMBRANCES FROM FEDERAL
GOVERNMENT DEPARTMENTS & AGENCIES1975-76

Laboratory & Supporting Services	\$2,333,000
Research Grants & Fellowships	3,276,000
	<u>\$5,609,000</u>

APPENDIX "25"

*The following pages consist of extracts from the brief submitted
by the NATIONAL RESEARCH COUNCIL OF CANADA*



2.2 Organizational Functions

In order to implement the responsibilities assigned to it by statute, NRC operations are organized in three separate programs, each supported financially by a separate Parliamentary vote:

Program A: Natural Sciences and Engineering Research

Objective

To provide a national foundation upon which to build for the creation, application and use of knowledge derived from the natural sciences and engineering.

Sub-Objectives

To promote, assist and perform research for the creation of new knowledge derived from the natural sciences and engineering.

To apply knowledge derived from the natural sciences and engineering to the solution of problems of national concern.

To apply and use engineering and the natural sciences to assist industry in Canada with the development of new and improved processes, methods, products, systems, techniques and services.

To develop and maintain national standards and criteria based on the natural sciences and engineering.

Program Description

- Basic and Exploratory Research in the Natural Sciences and Engineering: development of engineering

fundamentals; acquisition of new engineering technologies; discovery of new applications for engineering technologies; development of scientific competence; acquisition of new scientific knowledge; discovery of new applications of science.

- Research on Long-Term Problems of National Concern:
application of engineering and scientific expertise to the solution of long-term problems of national concern, such as transportation, energy, food, building, and construction.
- Research in Direct Support of Industrial Innovation and Development: performance and promotion of exploratory and applied research in selected areas for the advancement of technology required for Canadian industrial development; use of effective methods of technology transfer, financial assistance, and selected cooperative projects on processes, systems, materials, and products to strengthen the research, development, and innovative capacity of industry in Canada.
- Research to Provide Technological Support of Social objectives: application of scientific and engineering expertise in support of national objectives such as health, law, safety, environmental quality and quality of Canadian life.
- National Facilities: provision and management of

national research and development facilities as a service to industry, governments, and universities.

- Research and Services Related to Standards: research in primary physical standards and provision of services in support of national and international standards,
- Administration: administrative support including financial and personnel services for this and other programs of the Council.

Program B: Scholarships and Grants in Aid of Research

Objective

To promote and support the development and maintenance of research and the provision of highly qualified manpower in the natural sciences and engineering.

Sub-Objectives

To support excellence in research for the creation of new knowledge in the natural sciences and engineering.

To promote and support the development of research in selected fields of regional and national importance.

To assist in the provision and development of highly qualified manpower.

Program Description

- Peer-Adjudicated Grants: grants for research expenses and equipment costs awarded to selected

individuals and groups by peer adjudication.

- Developmental Grants: grants negotiated with individuals, groups, or institutions to resolve problems related to scientific, economic, and resource development.
- Training and Development of Highly Qualified Manpower: scholarships and fellowships awarded in national competitions to graduate students, postdoctorate fellows, and senior scientists and engineers in universities and Canadian industry for advanced study, research, or professional development - tenable in universities, industrial firms, and other institutions in Canada or abroad.
- National and International Activities: grants to support national and international scientific and engineering conferences and studies, the exchange of scientists and engineers, and selected activities of scientific and learned institutions.

Program C: Scientific and Technical Information

Objective

To facilitate the use of scientific and technical information by the government and people of Canada.

Sub-Objectives

To provide and maintain services associated with scientific and technical information to meet the needs

of the government and people of Canada.

To conduct research into the need for and methods of accomplishing the transfer of scientific and technical information in response to user needs.

To participate in the provision of library and information services for the government and people of Canada.

Program Description

- Information Services: operation and support of services to provide for the collection, storage, retrieval, analysis, and transfer of scientific and technical information; support for the publication of journals of research in engineering and science.
- Network Implementation: implementation and maintenance of a Canadian network of scientific and technical information services, including a referral service; the establishment of links with other national and international networks and services.
- Research and Development: research into the requirements for collection, storage, retrieval, analysis, and transfer of scientific and technical information; improvement of these and other related processes and development of new processes to meet

the demonstrable needs of the users; development of standards, procedures, and processes for intersystem exchanges of scientific and technical information through participation and agreement with other national and international organizations.

2.2(a) Statutory Functions and Powers

NRC's statutory functions and powers are described in the National Research Council Act, R.S., C.N-14, amended by R.S., C.14 (2nd Supp.), 1973. The second supplement of the Revised Statutes of Canada adds to the powers of Council by authorizing it "to operate and administer any astronomical observatories established or maintained by the Government of Canada."

2.2(b) Organizational Policies

The National Research Council concentrates on those responsibilities explicitly assigned to it by statute, and includes those activities that are deemed highly important from a national standpoint, but which, for various reasons, cannot be done by other agencies.

The following specific policies relate to the above-mentioned role:

- In order to remain in the forefront of scientific and engineering research, NRC performs basic and exploratory research for the creation and application of new knowledge. The level of this effort

constitutes between one-quarter and one-third of NRC operations.

- NRC places emphasis on research in promising areas of advanced technology and on research related to long-term problems of national concern, such as energy, food, building and construction, and transportation.
- NRC's industrial research and development role complements and reinforces R&D in Canadian industry by the development and transfer of technology and by direct assistance to R&D projects in industry.
- Within its competence, NRC provides research support toward social objectives such as public safety and security, protection of property, health, and environmental quality.
- NRC establishes and manages major scientific and technical facilities that serve a variety of users.
- NRC provides a national reference centre for standards of measurement and performance.

Because of NRC's non-regulatory nature and independence as a research agency with broad scientific expertise, it is frequently called upon for consultation or to undertake investigations on specific matters. In some cases this amounts to what could be described as a "scientific ombudsman" task. Accordingly:

- NRC recognizes an obligation to provide, within its competence, independent investigation of scientific and technical issues that are in the national interest.

2.2(c) Functions and Responsibilities

In addition to the primary role of NRC set out above, its research activities necessarily interface with, and complement, those of other government laboratories, industries and universities. The following policies define these interrealtions more explicitly:

2.2(c) (i) Relations with Other Federal Agencies

Federal government departments with no laboratories of their own or departments with specialized R&D programs frequently require assistance in areas in which NRC has expertise or facilities. In addition to providing such assistance, NRC also has a continuing responsibility to do work of importance to Canada which does not fall within existing departmental missions or which broadly encompasses a number of missions. The following specific policy statements have been adopted:

- In selected program areas, either through the NRC mandate or by specific agreement with government departments and agencies, R&D undertaken by NRC may be directly related to the program of federal departments and generally constitutes a specified

or complementary research component of an integrated federal program.

- NRC engages in cooperative research and development at the project level with researchers in individual government departments and agencies.
- Within its capabilities, NRC responds positively to requests from federal departments and agencies for service from its unique facilities.
- NRC provides scientific and engineering advice, as appropriate, in support of other federal departmental programs when the required expert knowledge resides within NRC. As an independent agency, NRC does not accept responsibility for regulatory activities of government departments and agencies.

2.2(c) (ii) Relations with Industry

Within its capabilities, NRC meets the research needs of industry in Canada through the research of its laboratories, staff consultations, information services, project grants or contracts, and other forms of assistance. NRC complements research in industry and, where feasible, it encourages and assists R&D projects in industry. A significant aspect of NRC's industrial activity takes place through the extramural industrial program, as described in section 2.7(b) (II). Emphasis is being given to a closer coupling of NRC Laboratory research and industrial R&D in selected projects. This involves

increased NRC initiatives in developing collaborative research projects with industry. Project proposals developed by NRC laboratories for collaborative work to be carried out in industry are eligible for assistance through grants or contracts.

These and other approaches are directed toward a more effective transfer of technology from NRC Laboratories to industry. Specifically:

- NRC has developed from existing resources, including the Industrial Research Assistance Program and NRC Laboratories, a program specifically directed to enhancing applied research and technological development, and its transfer into industry. This involves the formation of joint NRC/industry teams to work on selected projects which may be initiated by either industry or NRC. In either case, the funding is subject to negotiated agreement.
- NRC work on a proposed industrial technology is pursued to a point where a competent company or group of companies can see its value and is prepared to take over final development and application. Bringing a company or companies to this point usually requires that they participate in the research at an early stage. Assignment to a

company depends upon the company's overall capability and on its plans regarding exploitation.

- NRC encourages and assists in the creation and strengthening of R&D teams in industry, through the introduction of new staff and exchanges between industry, the universities, and the NRC Laboratories.
- NRC provides scientific and engineering advice and assistance in solving technological problems in support of Canadian industry when the appropriate expertise is available at NRC.

2.2(c) (iii) Relations with Universities

A major part of the NRC role in respect of universities is carried out through the extramural program of Scholarships and Grants in Aid of Research as described in section 2.7(b)(I). To maximize the utilization of the scientific and engineering research capability in Canadian universities which NRC has fostered over the years, it is desirable that strong interactions be maintained between NRC, industry, and universities:

- In fields of research where NRC has identified the possibility of significant advances in fundamental techniques, maximum collaboration is sought from university researchers.
- NRC participates in cooperative and collaborative research programs with Canadian universities,

through agreements or contracts, when the results of such research are considered to be a contribution to national research and development programs in which NRC has a defined responsibility.

- NRC continues to encourage the interchange of scientific and engineering personnel between NRC and university laboratories.

2.2(c) (iv) International Representation

NRC acts as a focal point for Canadian international scientific and engineering affiliations, being the responsible body for 12 of the 17 member unions of the International Council of Scientific Unions (ICSU), to which Canada adheres. In addition, Canada, through NRC, adheres to several special and scientific committees of ICSU and to independent scientific associates of ICSU, such as the Pacific Science Association. NRC is also responsible for Canadian adherence to some 10 similar bodies such as the International Society of Soil Mechanics and Foundation Engineering. It cooperates with the Engineering Institute of Canada in regard to the World Federation of Engineering Organizations and the Pan American Federation of Engineering Societies.

Canada has intergovernmental agreements for cooperation in scientific and technological matters with the U.S.S.R., Belgium, and Germany, and, less formally,

with France and Japan. It also participates in scientific and technological activities of multilateral intergovernmental organizations such as UNESCO, OECD, NATO, and the International Energy Agency. NRC, in consultation with the Department of External Affairs and other departments and agencies acts as the Canadian representative for these bilateral and multilateral activities on matters pertaining to NRC's responsibilities. Occasionally, as in the case of UNESCO's Man and the Biosphere program and the Global Atmospheric Research Program of the ICSU and the World Meteorological Organization, it has been necessary to set up Canadian national committees to involve a wider portion of the scientific community. Alternatively, an existing NRC Associate Committee can be used; for example, the Associate Committee on Hydrology represents Canada in UNESCO's International Hydrologic Program.

NRC has exchange agreements with the Academy of Sciences of the U.S.S.R., the Centre National de la Recherche Scientifique of France, the Academy of Sciences of Czechoslovakia, and the Japan Society for the Promotion of Science. It manages the scientific part of the General Exchanges Agreements with France (intergovernmental) and, using funds provided by CIDA, manages an exchange agreement between NRC and the Conselho Nacional de Pesquisas of Brazil.

2.2(c) (v) Relations with Provincial Research Institutes

Since a number of provincial research councils and foundations have objectives somewhat similar to NRC's national role, NRC's activities are, where possible, related to those of provincial institutions in a series mode rather than in parallel.

It is considered desirable to have engineering and scientific R&D resources accessible to the need for such resources. It is therefore NRC policy to regard provincial institutions as having prior responsibility for the satisfaction of provincial needs within their capability. NRC responds to requests that cannot be thus satisfied.

NRC is prepared to engage more actively in cooperative R&D with provincial agencies when the unique capabilities of both can be jointly employed to further a national R&D purpose. Cases in point:

- Participation in the development of a federal energy R&D program.
- Collaborative development of a food R&D program.
- Participation with an industrial consortium in the provision of a Remote Manipulator System for the NASA space shuttle program.
- A pilot project to assist in evolution of joint industry/laboratory programs.
- A pilot project to assist in evolution of joint university/laboratory programs.

- Collaboration with university and government scientists in astronomy and space research.
- Collaboration with provincial non-profit research organizations in the provision of technical information to small and medium manufacturing industries.

2.2(d) Process of Review

The President of the National Research Council reports to Parliament through a minister, in contrast to the deputy minister of a government department who reports to the minister. The regular review by Council of the duties, goals, and work of the agency provides the mechanism by which Parliament can be assured that the directions followed are in keeping with national purposes. The methods used by Council to plan and monitor projects are described in the answer to question 2.7. This mode of operation ensures that due consideration is given both to short-term needs and long-term benefits.

The NRC Management Committee carries out strategic and tactical studies for consideration and concurrence by Council. By delegation from the President, the members of this Committee assume responsibility, authority, and accountability for specific activities within the total NRC program.

Council itself carries out a continuing review of programs and program priorities. This process takes place through ad hoc Council review committees that

examine the program goals, activities, achievements, and proposed future directions. The results of such an examination are measured against NRC policies and objectives, and conclusions are presented for Council's consideration and recommendation.

In addition, NRC is subject to scrutiny by the Treasury Board, cabinet committees, and parliamentary committees such as the Miscellaneous Estimates Committee, as well as the office of the Auditor General.

2.2(e) Outside Studies

This function is fulfilled by the duly appointed members of Council.

2.2(f) Responsibilities, Powers, Programs

In response to the powers assigned to the Council under its Act "to undertake, assist, or promote scientific and industrial research," NRC has developed a capable and productive laboratory program, a shared-cost program to develop research capability in industry, and a grants and scholarships program to foster research in universities. These programs have not remained static; changes have occurred and are occurring that respond to changing Canadian priorities in respect of laboratory research programs, support for university research, pilot programs to link research activities in government, university, and industry, and a scientific and technical information program that serves all sectors.

2.2(g) Hindrances

The expansion of scientific and engineering activity since the war resulted in a steady increase in the number of researchers employed by NRC Laboratories, reaching approximately 600 by 1967. Since 1968, the total number of researchers has remained constant, although their average salary continued to increase as a result of contract settlements and promotions. This has resulted in a decreasing proportion of the budget of the NRC Laboratories being available for the purchase of equipment, supplies, and services. Against a background of rapidly increasing costs, the effect has been to reduce dramatically the ability of the Laboratories to purchase new equipment. Since many kinds of modern scientific instruments become obsolete in approximately 10 years, the Laboratories are in danger of losing their position in the forefront of scientific endeavour. Moreover, with limited ability to purchase new equipment, it becomes more difficult to introduce new projects or to change the direction of existing projects.

The constant number of researchers during the past seven years has also affected their average age, which reached 44 years in 1973, compared with 35 years in 1953. The average age appears to have stabilized during the past two or three years, partly because of a trend towards earlier retirement. It is widely held that the average

age of a research community should not only be stable, but also considerably lower than the present value for NRC researchers. Unless more young scientists and engineers can be recruited, it is unlikely that the average age can be reduced substantially.

The ever increasing administrative demands placed on the National Research Council, without the provision of more administrative personnel, have resulted in the diversion of research staff, particularly directors and sectional heads, from the tasks for which they are best suited. This diversion is considered to be a significant hindrance to the management of the research laboratories.

In industrial research, the development of long-term policies to guide Canada's industrial development will be of immeasurable assistance in selecting those areas of research and development that could return the maximum benefit to Canada. Such policies should allow not just for the support and fostering of industrial research and development, but should also ensure that the results of research and development can be exploited in Canada for the benefit of all Canadians.

2.2(h) Forecast Changes in Organizational Function

NRC, with its strong scientific and engineering ties throughout Canada, and with the appropriate program activities, is in a strong position to bring together in a confluence of interest, the R&D capabilities of the

three sectors (government, industry, and university) to deal with problems of ongoing national concern.

At the present time, NRC has research laboratories in Ottawa, Saskatoon, and Halifax, with smaller groups in other locations. In order that the National Research Council can fulfil its role as a national body responsive to the needs of Canadians in all parts of Canada, it is anticipated that additional laboratories will be established in other parts of Canada in the future.

2.7 Research Policies

2.7(a) *Units Concerned with Intramural Research Activities:*

THE NRC LABORATORIES

2.7(a) 1. The Selection and Initiation of New Projects

Proposals for new research projects either originate within NRC Laboratories or arise from NRC's interactions with other federal government departments or agencies, provincial research organizations, industry, the university community, or individual professionals from related disciplines. All proposals are reviewed with respect to the following considerations:

- The priority of the relevant program element,
- The chances of scientific, technical, and economic success,
- The significance of success and the perceived benefits,
- The relationship to ongoing projects,
- The external sources of appropriate expertise,
- The federal government's Make-or-Buy Policy,
- The role of other federal government departments or agencies,
- The availability of intramural resources and expertise.

The selection and initiation of projects are based on defined roles, policies and program objectives. However, just as the proposals for new projects vary in scale, scope and resource

requirement, so the processes of selection and initiation vary according to the nature of the proposal. The processes for a particular project depend on such factors as:

- The scale of the project,
- The requirement for new or reallocated resources,
- The agreed role of NRC,
- The relevant program element,
- The source of the proposal,
- External interests.

The complexity of the processes and the levels of management involved, as well as the degree of involvement of other organizations, tend to increase with the scale and scope of the project. Three broad categories exist in practise:

- (i) The simplest procedure is that for short projects which can be funded by existing resources. Selection and initiation is at the discretion of the laboratory director or section head, or, as is often the case in basic research, at the discretion of the individual researcher.
- (ii) Many new projects require additional resources or reallocation of existing resources. The consideration of these proposals is a continuous process, but in most cases selection and initiation are phased with the budgetary cycle. Research priorities are

implemented through these decisions and, although the initial focal point is the Tactical Studies Committee, all levels of management are involved.

- (iii) Proposals for major projects that may involve other organizations, either Canadian or foreign, are subject to a complex procedure of selection and initiation in which the Council and senior management consult with other federal departments or agencies, or with industry.

2.7(a) 2. Research Priorities

The NRC Laboratories respond to changing needs through the designation, evaluation, and implementation of priorities within their program. The considerations involved in the assessment of current priorities and the establishment of new priorities are:

- National needs,
- Regional needs,
- Federal government goals and objectives,
- NRC's objectives and sub-objectives,
- The role of NRC vis-à-vis other government departments, industry, and universities.

Priorities are implemented either through the allocation of new resources or the reallocation of existing resources. However, the response to a change of priorities can be a relatively slow process, determined partly by the response time of the budgetary cycle

and partly by the problems inherent in terminating existing projects or quickly changing their direction. These problems are discussed in section 2.7 (a) 6.

2.7(a) 3. Project Planning and Monitoring

Although formal network methods such as CPN or PERT are not in general use for the planning and monitoring of individual projects, NRC has established mechanisms and units for the coordination, planning, and monitoring of projects within the new program structure. Overall monitoring and review of all projects forms an integral part of the annual budgetary cycle.

In addition to normal management of research projects by laboratory directors and the Tactical Studies Committee, coordinators have been appointed for NRC's work in certain projects, for example, the federal government's Energy Project. Another mechanism is the appointment by Council of ad hoc external review committees to evaluate the research done by the NRC Laboratories.

The work of the Atlantic Regional Laboratory, the Division of Building Research, the Division of Mechanical Engineering, and the Prairie Regional Laboratory is monitored by Advisory Boards composed of members from other organizations who are distinguished in appropriate fields. The work of the staff of NRC Laboratories that is published in scientific and engineering journals is subject to critical review by independent referees selected by the editors. This provides an effective mechanism

of monitoring the quality of research, especially that of basic research. Finally, the programs of the National Research Council are reviewed annually by the Secretariat of the Treasury Board.

2.7(a) 4. "Contracting Out" Policy

The implementation of this policy by NRC is described under the following headings (i) Pilot Industry-Laboratory Program, (ii) Unsolicited Proposals, and (iii) Direct Contracts with Industry or University.

(i) Pilot Industry-Laboratory Program

The objective of the program is to assist in the application of research results, especially those of NRC Laboratories, to situations where there are important Canadian industrial opportunities. The program assists in the transfer of technology to Canadian industry.

The funds are used to help Canadian companies realize specific industrial opportunities arising from scientific and technical developments in the NRC Laboratories. The work normally comprises R&D or pilot studies by the company designed to test and develop a specific application. Each case is covered by a contract or research agreement.

The work supported under this program is normally of the type that would closely follow patent application or publication by NRC staff. Therefore assistance from an interested NRC division is essential for the success

of projects under the program. This assistance ranges from simple advice and consultation, through technical guidance, to direct involvement in the R&D as a partner.

The following projects are supported by the Pilot Industry-Laboratory Program:

- Analytical Photogrammetric Plotter (Instronics Ltd., Stittsville, Ontario): to advance the technology and establish a practical design.
- Triply Redundant Clock (Edmunde Newhall Associates Ltd., Rexdale, Ontario): to design and construct a triply redundant clock code generator to compare three cesium clocks and transmit a consensus time signal (Case history, page 265).
- Film-Coating Prototype (Sentrol Systems Ltd., Toronto, Ontario): to mass produce optical multilayer coatings for the prevention of counterfeiting (Case history, page 309).
- Diagnosis of Gonorrhoea (M.D.S. Health Group Ltd., Toronto, Ontario): to develop commercial clinical tests for the diagnosis of gonorrhoea (Case history page 259).
- Tar Sands (Terra Energy Ltd., Calgary, Alberta): to extract bitumen from Alberta Tar Sands by spherical agglomeration (Case history, page 313).
- Snack Foods from Pea Products (Pro-Star Mills Ltd., Saskatoon, Saskatchewan): to develop a commercial

process for the production of snack food chips from field pea flour (Case history, page 332).

- Tuneable Gas Laser (Lumonics Research Ltd., Kanata, Ontario): to develop a commercial high-power laser (Case history, page 306).

(ii) Unsolicited Proposals for Research and Development

Unsolicited proposals are administered by the Science Procurement Sector of the Department of Supply and Services. The proposals, which may come either from industry or university, are circulated to various departments. If a department is interested in sponsoring the proposal, it must commit funds thereto, although the Department of Supply and Services may provide temporary "bridge funding."

The National Research Council has established an Industrial Programs Office to expedite consideration of these proposals, and to provide a focus for liaison with the Department of Supply and Services.

The following projects resulted from Unsolicited Proposals:

- Study of the Potential for Solar Heating of Buildings in Canada (University of Waterloo, Ontario).
- Development, Construction, and Testing of a Vertical Axis 200 kW Wind Turbine (Dominion Aluminum Fabricating Ltd., Mississauga, Ontario).

- Soil Disturbance from Pile Driving in Sensitive Clay
(Terratech Ltd., Montreal, Quebec).
- Instrumentation of a Water Intake Tunnel Deep in Bedrock
(William Trow Associates, Rexdale, Ontario).
- Development of a Pulsed TEA laser for Paper Cutting
(Gen-Tec Ltd., Quebec, Quebec).

(iii) Direct Contracts with Industry or University

In addition to the foregoing programs, there are many examples of specific projects being contracted-out by individual NRC divisions to industry or university. A notable example is provided by the Division of Biological Sciences, which has let research contracts to obtain new information needed in the establishment of scientific criteria on the effects of environmental pollutants by the Associate Committee on Scientific Criteria for Environmental Quality (Table 2.7.I).

A sample of contracts let by the National Research Council in support of its laboratory research programs is presented in Table 2.7.II.

2.7(a) 5. (i) Extramural Research Policies

The extramural research policies of NRC Laboratories are outlined above, in section 2.7 (a) 4. However, two NRC programs (Scholarships and Grants in Aid of Research, and Industrial Research Assistance) are concerned exclusively with extramural research, and their policies are discussed in section 2.7.(b).

by the Canada Institute for Scientific and Technical Information,

- Ensuring liaison between laboratory personnel and the various Associate Committees of Council,
- Supplying industry with lists of publications and laboratory reports,
- Organizing informal seminars or meetings in selected fields of science and engineering.

The National Research Council emphasizes the transfer of technology from its Laboratories to industry. In addition to personal consultation with its laboratory staff, the National Research Council has developed the mechanisms for the transfer of technology that are described in section 2.7 (a) 4.

2.7(b) Units Exclusively Concerned with Extramural Research Activities:

The National Research Council has two programs concerned exclusively with extramural research activities. These are (I) the program of Scholarships and Grants in Aid of Research and (II) the Industrial Research Assistance Program. These two programs support, respectively, research in universities and industry.

2.7(b) (I) SCHOLARSHIPS AND GRANTS IN AID OF RESEARCH

The fundamental objectives of the National Research Council in awarding grants and scholarships are to support the development and maintenance of broadly based research

competence in the natural sciences and engineering in Canadian universities and to support the formation of highly qualified manpower in these fields. The Council, with the assistance of its Committee on Grants and Scholarships, develops programs of grants and scholarships, and the policies to be applied in their implementation.

The Office of Grants and Scholarships implements the policies and procedures developed by Council for the use of the funds provided under Parliamentary Vote Number 35, "Grants and Scholarships to Universities." The Office also administers a program to encourage collaboration in research between universities and industry, a program of fellowships to encourage doctoral graduates to seek industrial careers, and a NATO Science Committee Fund of approximately \$190,000 a year.

The Annual Report on Scholarships and Grants in Aid of Research, 1974-75, is submitted as Exhibit 1.

2.7(b) (I) 1. Process of Acceptance

Applications for research grants from individual university researchers are assigned by discipline to the most appropriate of twenty-two Grant Selection Committees. Each committee is composed of between eight and thirteen members who are experts in the disciplines considered by the committee. The majority of the members of the committees are university professors.

Applications are considered by the committees once a year. Two or three members offer the committee detailed reviews of each application before the whole committee makes its decision. Committees also seek the opinion of reviewers who are not members of the committee, and arrange on-site visits as required.

The excellence of the researcher and of the proposal are considered by the committee in deciding awards to individual researchers. The record of achievement of the unit in which the researcher works may be considered in the assessment of applications for major equipment costing more than \$50,000 that is intended for use by a team of researchers.

The following types of grant are adjudicated by committees of experts who assess the merits and likelihood of success of the proposals:

- Negotiated Development Grants: large consolidated grants awarded to groups of researchers to establish special research capabilities in promising areas of study,
- Projects of Research Applicable to Industry: grants which enable university researchers to develop an idea to the stage at which it can be taken over by a company.

2.7(b) (I) 2. Establishment of Priorities

There are two levels of priorities. The first level provides an appropriate allocation of the available funds among the various disciplines represented by the Selection Committees. The second level determines the value of the individual project grants made by the Selection Committees.

The distribution of funds between the selection committees is made by Council following recommendations of the Committee on Grants and Scholarships, which are developed by its Subcommittee on Allocations. These recommendations are based on advice concerning the effectiveness of and the requirements for the various types of grants and scholarships. This advice originates with the Council's Advisory Committees, the Selection Committees, and the research community at large.

Priorities among the individual applications are established by the Selection Committees on the basis of policies approved by Council.

2.7(b) (I) 3. Monitoring and Evaluation

Grants to individual researchers are monitored annually, mainly by the review of progress reports, publications, patents, and presented papers that arise from the work. Major projects are monitored through visits by representatives of the Grant Selection

Committees or the Office of Grants and Scholarships or both.

2.7(b) (I) 4. Implementation of Priorities

The priorities established by Council and the Committee on Grants and Scholarships are implemented by this committee in its allocation of funds to the various programs of grants and scholarships. The priorities established by the selection committees are implemented by acceptance of their recommendations of the sum of money to be awarded to each applicant.

2.7(b) (I) 5. CPN, PERT Network Methods

None.

2.7(b) (I) 6. Shifting of Resources

Changes in the allocation of research resources are made by Council on the recommendation of the Committee on Grants and Scholarships. A current example is the decision to suspend the program of Negotiated Development Grants for one year, due to financial constraints and the need to re-evaluate the program in this context.

2.7(b) (I) 7. Transfer of Research Results

The primary method of transferring university research results to those having potential need of them is by means of publications in scientific and engineering journals. In addition, the results of work conducted with the aid of grants for Projects of Research Applicable

in Industry are transferred directly to industry.

2.7(b) (I) 8. Funds Expended/Available

All the funds made available annually are expended.

2.7(b) (I) 9. Funds Granted/Requested

Total funds granted represent close to 50% of the total funds requested.

2.7(b) (II) THE INDUSTRIAL RESEARCH ASSISTANCE PROGRAM

The Industrial Research Assistance Program was authorized by Cabinet in November 1961 and the National Research Council was made responsible for administering the program on 1 April 1962. The original authorization of the program defined its purpose as follows: "To establish a number of competent research teams in industry each year over a period of years. The R&D projects submitted by industry should be judged on their merits with this general purpose in mind." The original authorization also specified that the industry contribute at least half the cost of a project, but that all rights arising out of the research should be the property of the company concerned.

A Committee on Industrial Research Assistance was set up by NRC to review policies and procedures for the administration of the program, to screen applications, and to approve financial aid. This committee is composed of senior staff from NRC and from other government agencies that have a direct interest in industrial

research, including Agriculture Canada, the Department of Energy, Mines, and Resources, Environment Canada, Communications Canada, the Department of National Defense, the Department of Industry, Trade, and Commerce, and the Treasury Board.

2.7(b) (II) 1. Process of Acceptance

Grants are awarded following detailed review of each project by the Committee on Industrial Research Assistance. The Committee is served by a secretariat which advises companies on the terms and conditions of the program and obtains expert opinions on each proposal for consideration by the committee. The secretariat obtains information for the committee which includes the following factors:

- the record of achievement of established firms,
or of individuals in new firms,
- the technical merit of the proposal,
- the plans of the company to use the results of the
research commercially,
- the ability of the company to fulfil the plans
successfully.

The allocation of funds is competitive, with grants being awarded to projects which best satisfy the priorities of the program. Competition is ensured by deliberately considering together a number of diverse projects.

2.7(b) (II) 2. Establishment of Priorities

The Committee on Industrial Research Assistance decides which industries are most likely to benefit from research assistance at any given time and the relative merits of assisting small and large companies. Priorities derived from these decisions are applied in the acceptance of proposals.

Within these broad guidelines, priority is given to projects that have great technical merit, that involve significant risk, but that offer substantial economic and social benefits if successful. Application of these priorities is calculated to improve the calibre and scope of the participating industrial R&D teams.

2.7(b) (II) 3. Monitoring and Evaluation

The progress and prospects for success of a project are assessed by representatives of the Committee on Industrial Research Assistance through visits to the project as required. These representatives are federal public servants bound by an Oath of Office and Secrecy to respect confidentiality. Discretion is observed in their assignments to avoid possible conflicts of interest between different and possibly competing firms.

Approximately 180 scientists and engineers from government laboratories serve as scientific consultants and liaison engineers. Annual reports are prepared

both by the company and the liaison staff. The firm and the secretariat of the Committee on Industrial Research Assistance each prepare a final report upon completion of a project.

2.7(b) (II) 4. Implementation of Priorities

The priorities established by the Committee on Industrial Research Assistance are implemented by this committee in its awards of grants for specific projects.

2.7(b) (II) 5. Network Methods

It is the responsibility of a firm to review the progress of its project in detail and to report to the secretariat. Several firms employ CPN or PERT methods. However, the purposes of the Committee on Industrial Research Assistance are satisfied by the measurement of progress towards predetermined goals at intervals of between three months and one year, depending on the duration of the project.

2.7(b) (II) 6. Shifting of Resources

Great emphasis was at one time placed on "good science" and "peer assessment" in the award, modification, and termination of grants by the Committee on Industrial Research Assistance. More weight is now given to market needs and opportunities, including the firm's prospects for eventual commercial success. Company managements are usually highly sensitive to

changes in such factors and it is relatively easy to reach agreement to change a project or to terminate it if these factors become adverse.

2.7(b) (II) 7. Transfer of Research Results

The research is performed in industry, with a commercial motive to exploit the results.

2.7(b) (II) 8. Funds Expended/Available

Cash expenditures are usually close to the target.

2.7(b) (II) 9. Funds Granted/Requested

Many proposals, before formal submission to the Committee on Industrial Research Assistance, are rewritten after consultation with the secretariat. Of the funds formally requested from the committee, between 75 and 80% are granted.

2.8 Research Output

2.8 1. Patents

The number of patents granted to staff of the NRC Laboratories, the licences issued, and the value of resulting production are presented in Table 2.8 1. I. The titles and inventors of these patents are presented in Table 2.8 1. II.

An analysis of the number of patents and licences, and the value of resulting production, is not readily available for the 5,000 university researchers who receive research grants from the National Research Council. The output of university research is overwhelmingly through publication in research journals. Nevertheless, grantees are encouraged to patent the results of their research and to make use of the services of Canadian Patents and Development Limited.

2.8 5. Transfer of the World's Scientific and Technical Data

The National Research Council, through the Canada Institute for Scientific and Technical Information, has developed a variety of mechanisms to facilitate the dissemination or transfer within Canada of scientific and technical data produced in other parts of the world. For example, using its extensive collection of international scientific and technical publications, the Institute responds to requests for factual information by lending books, by providing photocopies of papers, and through the retrieval and interpretive skills of its staff.

To supplement these services, the Canada Institute for Scientific and Technical Information has developed computerized techniques which are effective in transferring information. CAN/SDI (Canadian Selective Dissemination of Information) continuously alerts subscribers to the existence of recent papers covering their specific fields of interest. This service, which covers the world's scientific and technical literature (journals, reports, patents, and proceedings of conferences) is at present serving approximately 6,000 users seeking information in the various fields of science, engineering, and medicine. Augmenting this service is the CAN/OLE program (Canadian On-Line Enquiry). Through

34 centres and 160 video terminals located across Canada, this service permits users remote from Ottawa to search the world's scientific and technical literature and in a matter of minutes determine what has been published during the last 5-6 years in all the major fields of science and technology. At present, CAN/OLE is responding to approximately 10,000 searches or enquiries per month. The Canada Institute for Scientific and Technical Information backs up these services by ensuring the availability of copies of all cited papers.

2.8 6. Postdoctorate Fellows, Research Associates, and Visiting Scientists

In 1948 the National Research Council introduced a program of Postdoctorate Fellowships tenable in NRC Laboratories. Fellowship awards were made on the basis of an annual competition. The purpose of these awards was to provide opportunities for promising young scientists to develop their research careers and to broaden their research experience by working on advanced research projects in NRC Laboratories. This program, which was later extended to include other government laboratories, has been highly successful. The program also provided a pool of highly competent young researchers, actively sought for recruitment by universities, industries, and government laboratories. At the same time, the NRC Laboratories benefited

enormously from this flow of bright young talent and the contributions the Postdoctorate Fellows have made to NRC research programs.

With the recent revision of NRC's role and the challenges ahead, the time was opportune to take another step forward and to build on the proven features of the PDF program. In a number of NRC research projects, and this number will undoubtedly increase in future, a degree of continuity is required for the investigator to make a significant contribution. This is a particular feature of many engineering research projects and because of this constraint it has not been possible for Postdoctorate Fellows, whose tenure was restricted to one or two years, to participate fully in such projects. Yet this is a most important objective since such experience is invaluable for young researchers seeking a career in the industrial sector. Additionally, since most universities are now also operating PDF programs, it is deemed desirable that the NRC program should complement and extend existing university programs.

As of April 1, 1975 the earlier program of Postdoctorate Fellowships was terminated and replaced by a new program called NRC Research Associates. As previously, awards are made through an annual competition on the basis of demonstrated ability and promise to perform original research of high quality.

In lieu of a fixed stipend as for the former Post-doctorate Fellowships, Research Associates are offered salaries and staff benefits comparable to those currently available to members of the regular staff of the National Research Council. The initial award is for a period of one year and may be renewed at intervals for a total period of up to five years. Research Associates undertake and participate in advanced research projects of interest to NRC Laboratories.

The numbers of appointments to positions in NRC Laboratories under these programs since 1968 are as follows:

Postdoctorate Fellows	1968-69	76
	1969-70	73
	1970-71	54
	1971-72	53
	1972-73	53
	1973-74	53
	1974-75	48
Research Associates	1975-76	61

A complementary program is the Visiting Research Scientist Program which is designed to bring into the laboratories high quality researchers from government, industry, and universities in Canada and abroad to engage in cooperative research programs with the laboratory staff. Under this arrangement, the visiting scientist is given a short-term appointment to work in the laboratories (normally for a period of one year or less). The plan is intended to stimulate the research

effort of the organization and to help ensure the vitality of the laboratory by the infusion of new blood and a fresh outlook. The program also provides the visiting scientists with the opportunity to broaden their scientific knowledge or increase their technological skill by working with highly qualified laboratory personnel. This type of direct contact is found to be a successful means of effecting a transfer of technology and maintaining close cooperation between laboratories and institutions. A list of visiting scientists, together with their affiliation and the Division in which they worked, is given in Table 2.8 6. I to illustrate the scope of the program.

2.9	2. <u>Case Histories</u>	Page
	<u>Basic Research</u>	
-	Synthesis of the Lactose-Operator Gene of E. Coli,	236
-	Studies of Muonic and Quantum Electrodynamics,	240
-	The Diameters of Quasars and Seyfert Galaxies,	245
-	The Spectrum of the Water Ion and Its Identi- fication in the Tail of Comet Kohoutek,	251
-	Somatic Hybridization of Plants.	254
	<u>Applied Research</u>	
-	Antigens of Pathogenic Bacteria,	259
-	The NRC Primary Cesium Clock (C _S V),	265
-	Mechanisms of Outdoor Sound Propagation and Insulation of Dwellings Against External Noises,	269
-	Durability of Building Materials,	273
-	Cold Regions Engineering Research,	277
-	Fire Research Activities,	281
-	Development of Tubular Membrane Technology for Reverse Osmosis Applications,	287
-	Police Science and Police Equipment,	292
-	Miramichi Channel (N.B.) Study,	295
-	Industrial Aerodynamics,	299
-	Irish Moss.	304

<u>Development</u>	<u>Page</u>
- High Power, Large Volume, U.V. Pre-Ionized CO ₂ Lasers,	306
- Optical Multilayer Coatings for Anti-Counter- feiting Purposes,	309
- Extraction of Bitumen from Athabasca Tar Sands,	313
- An Energy-Conserving Railway Switch Protector,	317
- Biomedical Engineering,	323
- Wind Power,	328
- Development of Legume Seeds,	332
- Development Projects of the Canadian Institute for Scientific and Technical Information.	337

SYNTHESIS OF THE LACTOSE-OPERATOR GENE OF E. COLI

The history of this project goes back some 10 years and is based upon a decision that one of the major future directions of organic chemistry would be towards its applications in biology and biochemistry. Accordingly, two young scientists were engaged, one with interests in peptide synthesis (polymers of amino acids), the other interested in synthesis of nucleic acids (polymers of nucleotides). The latter, Dr. S.A. Narang, had been a research associate with Dr. H.G. Khorana and had contributed substantially to the work for which the Nobel Prize was awarded.

Dr. Narang set out to develop practical methods for the synthesis of nucleic acids with the eventual aim of synthesizing a gene. Basically, this involves the condensation of four different nucleotides (phosphorylated ribosyl bases) in known sequences that duplicated the sequence in a natural gene. The initial stage was to find improved methods for condensing two nucleotides and then extension of those methods to the condensation of larger blocks. Results of this phase of the research yielded new condensing reagents and new phosphorylating reagents. The next phase of the work was to devise better methods for separating condensation products from unreacted starting material. The magnitude of this problem is best illustrated by an example. Suppose that an 8-membered polynucleotide is to be condensed with

a trinucleotide to give an 11-membered nucleotide. Even if the condensation is 90% effective (a high yield for an organic reaction) there will be 10% of unreacted starting compounds along with the desired product. The mixture then contains polynucleotides with degrees of polymerization of 3, 8, and 11. The trinucleotide is sufficiently smaller to be separated from the other two but there is little chemical or physical difference between the 8- and 11-membered products. The problem becomes even greater as the nucleotide chain gets longer as required for gene synthesis. To solve this problem Dr. Narang devised ways to insert a specific chemical grouping into the desired product and also developed an affinity chromatography procedure for isolation of compounds with that grouping. Another major step in the project was the discovery that nucleotides beyond a certain degree of polymerization could be condensed by an enzyme, "ligase".

With the development of efficient condensation methods (both chemical and enzymic) and separation techniques the work turned to the practical synthesis of a gene. The one chosen was the "lac-operon" of E. coli because it was relatively short as genes go (21 nucleotides), the specific sequence of nucleotides in the gene had been established, and its biological activity could be assayed through specific binding by its repressor protein that was also available. This synthesis was completely successful and represents the first synthesis of a gene with full biological activity.

The series of papers that have reported this work have been accepted by the most prestigious scientific journals in the world and have attracted wide attention in the scientific community. Dr. Narang has received an award from the Indian Chemical Society of which several previous winners are now Nobel Laureates, he has received numerous requests to lecture on his work and has been invited as a feature speaker at the next congress of the Organic Chemistry Division of the International Union of Pure and Applied Chemistry. There is little doubt that the procedures developed here are generally accepted throughout the scientific community as the best and most practical approach to gene synthesis. The impact of this work is likely to be even greater as progress is made in recombinant DNA experiments, the so-called genetic engineering. Again, an example will help to explain. It is theoretically possible to extract, from a pancreas, genetic material that contains the gene that codes for insulin. This genetic material could then be introduced into the common bacterium E. coli, by recombinant DNA techniques, and there would be a reasonable possibility that the E. coli would then produce insulin as a metabolic product. One could then produce insulin in whatever quantities desired by a simple fermentation procedure independent on any animal source. The problem arises in that the genetic material from a pancreas contains many other genes, in addition to the insulin gene, whose

activities are unknown and unpredictable under recombinant conditions. That is the reason why animal-bacteria recombinant DNA experiments have been banned by mutual agreement within the scientific community. However, the objections would be greatly reduced if the genetic material introduced in the recombinant DNA was totally synthetic, chemically and biologically defined, and free of any extraneous or "hidden" genes. The advances made here in the synthesis of polynucleotides represent at least a first step towards that goal.

It is interesting to note that this project provides demonstration (in addition to the one on pathogenic bacteria) of the difficulty of distinguishing between "basic" and "applied" research in biological science. Although this project has been categorized as "basic", it has yielded four patents. One of these has already been licenced and the product is being marketed. Other companies are actively negotiating for licences of the other three patents. Thus, the so-called "basic" research has yielded four new products that the chemical industry considers worthwhile.

STUDIES OF MUONIC ATOMS AND QUANTUM ELECTRODYNAMICS

Evolution of scientific knowledge comes, in large part, from a continuing interaction between experimental observations and theoretical models. The latter try to synthesize and simplify the former; the former challenges and tests the predictions of the latter. Better measurements usually lead to better theories and so advance our understanding of nature.

The interrelated phenomena of electricity and magnetism are extremely well understood. The theory that describes electromagnetic interactions at very small distances is called quantum electrodynamics (QED) and is by far the most successful of the modern "basic" theories, incorporating both quantum mechanics and special relativity.

The very success of QED is a special challenge to experimental physicists. Here theory is "ahead of" the experiments! There are a number of different precise measurements which critically test QED and one of the most critical of these is the determination of the values of certain transition energies in muonic atoms. A muonic atom consists of an atomic nucleus (any nucleus from hydrogen to uranium and beyond) to which is bound one negatively-charged muon, a heavy electron-like particle. Muons can be produced by particle accelerators with energies over a few hundred million electron volts and are spontaneously

radioactive with a lifetime of two millionths of a second. In two millionths of a second it is possible, however, to bring the artificially-created muon to a chosen target, to slow it down so that it can be captured by a nucleus in the target so forming a muonic atom, and to study the properties of that atom. The muonic atom has many of the features of the ordinary hydrogen atom, one of the best understood of all the fundamental physical systems; at the same time it has special properties, due to the large mass of the muon, which makes it more sensitive to some effects than is the ordinary atom.

In the early 1960's the NRC High Energy Physics group was involved in experiments with muonic atoms in collaboration with physicists at the University of Chicago, using muons produced by the University of Chicago cyclotron. (There were no accelerators in Canada of sufficiently high energy to produce muons.) They used the then currently standard sodium iodide crystal spectrometer to measure the energies of muonic atom "x-rays". (It should be noted that while ordinary atomic x-rays have energies in the thousands of electron volts region, muonic atom x-rays may run into millions of electron volts, an energy region usually associated with nuclear gamma rays.)

In 1964 came a break-through in technique. Scientists at the Chalk River Nuclear Laboratories of AECL developed the germanium crystal gamma ray spectrometer and applied it

successfully to nuclear gamma ray measurements. The early germanium spectrometer had about ten times better energy resolution than the old sodium iodide spectrometer, and so permitted energy measurements to correspondingly higher accuracy. The NRC group borrowed one of the first germanium spectrometers from Chalk River and took it to Chicago to make the first muonic x-ray measurements with the new device. A series of experiments at Chicago followed (with Carleton University joining the collaboration) which led to a number of new interesting results. Among the results of the NRC-Carleton-Chicago collaboration were the first observation of well-resolved fine structures splitting due to the spin of the muon, the first observation of resolved hyperfine splitting due to static and dynamic interactions with nuclei via their electron quadrupole moments, precise measurements of isotope shifts, polarization of heavy nuclei by the muon and radiationless transitions in the atom accompanied sometimes by nuclear neutron emission. By 1970 it was realized that improvements in germanium crystal resolution together with new electronic circuit measuring techniques developed at NRC and Carleton could be applied to make a critical test of the QED theory.

The results of the first experiment designed for this purpose, published in 1971, were, to everyone's surprise, in serious disagreement with the predictions of QED. Shortly

after, an independent measurement made in Europe was published and confirmed the discrepancy.

During the next four years a large number of theoretical papers appeared. Some corrected errors in earlier work, some refined the calculations, and others proposed novel explanations for the discrepancy. As a result the gap between theory and experiment was narrowed, but not completely closed, and so new measurements seemed warranted.

These were initiated by the NRC-Carleton-Chicago team in the fall of 1974. Since the Chicago cyclotron was by then shut down and dismantled, an arrangement was made to use a similar (and better) cyclotron at the Space Radiation Effects Laboratory (SREL) at Newport News, Virginia. Some preliminary measurements were made in the fall of 1974 and the experiment was completed late in 1975. All the 1974/75 results now seem to be in excellent agreement with the (revised) QED calculations and so add to the stature of the theory at the same time increasing the demand for still better experiments.

The conclusions about QED from muonic atoms depend on the fact that the mass of the muon is very precisely known from independent experiments. The mass of the pion (or pi meson), another important elementary particle which is apparently responsible for the forces that hold nuclei together, is less well known. In an extension of the 1975 measurements of muonic atoms, pionic atom transition energies

were measured with the same apparatus. If we now assume that the QED calculations are reliable, as indicated by the muonic atom results, we can turn the analysis around and extract the mass of the pion. The indications are that, when the analysis is complete, the present uncertainty in the pion mass will be decreased by about a factor of two.

To summarize, this project has led to the observation of several nuclear effects for the first time. More important, it has provided a critical test of QED, one of our most fundamental and most successful physical theories. It will yield a new better value for the mass of one of the most important elementary particles - the pion. It is also an excellent example of highly sophisticated physics being performed by a Canadian group at very modest cost. The provision of free beam-time on U.S. accelerators makes this type of project possible and underlines the value to Canadian science of international cooperation.

THE DIAMETERS OF QUASARS AND SEYFERT GALAXIES

The discovery in England by Hey (1946) of the radio source Cygnus A had far reaching consequences. Hey rightly deduced that Cygnus A had a small angular size. Later observations have shown that Cygnus A is composed of two sources each about 20 arc seconds in diameter.

Techniques and telescopes rapidly improved during the ensuing years. Soon astronomers were able to deduce that many radio objects could be associated with hot ionized gas in our galaxy or with distant galaxies. A few sources, however, appeared to have very small angular diameters, and were not readily identifiable with any known visible objects.

Radio interferometry, whereby one telescope was connected to another distant one by radio link, enabled astronomers to put an upper limit of less than one arc second on the angular diameter of these objects. The positional accuracy increased until they could be identified with stellar-like very distant galaxies (called quasars, for Quasi-Stellar Radio Sources).

Canadian astronomers, intrigued by the mystery of these very distant galaxies, were convinced that radio interferometry could be released from the restrictions imposed by interconnection. It appeared feasible to eliminate the cable or radio link interconnection by using independent time and frequency generators at each telescope, and by

recording the output separately on magnetic recorders. The magnetic tapes would be brought together later for cross correlation.

Scientists, engineers and astronomers from NRC, DRAO, University of Toronto, and from Queen's University met late in 1965 to explore the independent telescope possibility. Canada had two large radio telescopes separated by 3000 kilometers, one in Algonquin Park and the other at Penticton, B.C. In addition there was a large radar antenna at Prince Albert, Sask. These three instruments were separated in the ratio one to two giving separations between telescopes of 1000, 2000 and 3000 kms. This interferometry technique, if successful, would enable the astronomers to determine if any of the quasars had diameters less than 0.015 seconds of arc. Even at the large distance of the quasars this would represent a very small core to a galaxy. The project was, in a way, daring; such high resolution at radio wavelengths was almost 30 times the best obtainable at visible wavelengths. The existence of radio objects so small that they could be measured by this technique could only be conjectured. Successful measurements of small diameter components, however, could lead to new theories about the dynamics of quasars. So little was known about quasars at this period of time that the prospect of gaining some knowledge about the central core and, perhaps, about the explosive events in this core, presented an exciting challenge.

The experiment appeared to be feasible. The frequency standards had to have a stability such that the data could be integrated for several minutes. That is the signals from each of the recorders could not differ by a cycle in about 10 minutes. The time standard had to provide marks on tape that were reliable to better than a millionth of a second so that the signals could be cross correlated. Highly stable time and frequency standards had been developed for standard time laboratories by two U.S.A. manufacturers. This degree of frequency stability and time accuracy was just available with these commercial units for an experiment at a wavelength of 75 cm. There remained the problem of putting the radio signals on magnetic tape.

The sensitivity of a telescope receiver is proportional to the width of the band of signals received. Most magnetic recorders had a very limited bandwidth and this appeared to be a stumbling block. Recorders having sufficient bandwidth were possible to obtain at considerable cost, but their time stability was somewhat inadequate. The group then learned that some video magnetic tape recorders were being exchanged for new ones by one of Canada's leading T.V. networks. Careful appraisal of the specifications of these recorders convinced the group that the bandwidth and time requirements could be met by these old machines.

Simultaneously with this planning two groups in the U.S.A. were also attacking the problem of independent oscillator-

magnetic tape recording interferometers. Their approach was to record the data digitally and to perform the cross correlation by shifting the data in a large computer, a somewhat different approach than that taken by the Canadian team. Liaison between the three groups was constant and informal, and continued up to the successful detection of signals by this technique. (This liaison continues today on only a slightly diminished level.)

Early in 1967 the Canadian technique was proven with a short baseline separation between a small telescope and the 46 metre diameter telescope at the Algonquin Radio Observatory. Then in May, 1967 successful observations of the quasar 3C273 were obtained from recordings made simultaneously 3000 km apart, at Penticton, B.C. and at the Algonquin Radio Observatory. The Canadian team were pleased to be able to announce this observation just two days later at a joint U.S.A.-Canadian meeting of URSI being held at Ottawa. Within a few weeks the American groups were also successful.

One successful observation may prove a technique, but does not answer the questions posed by the enigmatic behaviour of quasars. Further, a number of different angular resolutions were required to sort out multiple components of some of the quasars. Correspondingly a number of observations were made between the three baselines in Canada. When this did not prove to be sufficient, observations were then made

between the Algonquin Radio Observatory and the 1000 ft. telescope at Arecibo, Puerto Rico, the 140 foot telescope at Green Bank, West Virginia, and the 250 foot telescope at Jodrell Bank.

This series of observations resulted in brightness distributions for 17 quasars and 2 Seyfert galaxies with notes on the structure of 14 other sources. The smallest scale structure recognized from these observations was about 0.005 arcseconds which corresponded to linear dimensions between 20 and 200 parsecs. The size of the emitting region in 3C84, a Seyfert galaxy, appeared to be only about 2 parsecs! By contrast our galaxy has a diameter of about 30,000 parsecs and the nuclear region, albeit poorly defined, has a diameter of about 3000 parsecs.

An interesting feature of these small diameter quasars is that they can have significant intensity variations at centimeter wavelengths on a time scale of weeks. To have such rapid variations they must have diameters of only a few light weeks or months. While much research remained to be undertaken at the wavelength of 75 cm. the Canadian and American groups commenced observations at much shorter wavelengths (typically 2.8 cm) where the intensity variations were large and rapid. Close cooperation exists between all groups involved in long baseline interferometry, and many joint observations are made in order to increase the number of simultaneous baselines.

Long baseline interferometry has a significant influence on theories pertaining to quasars. New results continue to produce surprising interpretations which cause a new flurry of excitement amongst the theoreticians. Canadians have continued to hold a respected place in this field with their contributions.

On April 14, 1971 the work the Canadian and the two American groups in the field of long baseline interferometry was recognized by the American Academy of Arts and Science, Boston, Mass. at its 1513th meeting, by awarding the Rumford Medal jointly to 9 Canadians and 12 Americans. The Academy was founded in 1779 for the "cultivation and promotion of Arts and Sciences." In 1796 Count Rumford donated a sum of money to be used for a medal to the "author of the most important discovery or useful improvement....." Fewer than 75 awards of the Rumford Medal have been made in the intervening 180 years. In 1971 the Academy broke from its tradition of an award to a single recipient to give the award to the three teams of researchers. It is a matter of interest that the only other Canadian award was made in 1930 to Dr. J.S. Plaskett of the Dominion Astrophysical Observatory for his stellar spectrographic researches.

THE SPECTRUM OF THE WATER ION AND ITS IDENTIFICATION
IN THE TAIL OF COMET KOHOUTEK

The spectra of molecular ions and free radicals have been the subject of investigations in the Spectroscopy Laboratory of the Herzberg Institute of Astrophysics for many years. (Prior to the formation of the Institute, the laboratory was part of the Division of Physics). Molecular ions and free radicals are transient species of molecules that are not normally found in the laboratory. However they can be produced under special conditions and many of them undoubtedly exist in the rarefied conditions of outer space. In fact it has been hypothesized (in particular by Herzberg) that many unidentified spectral lines observed in interstellar space are due to molecular ions whose spectra have not yet been seen in the laboratory. In a similar vein Fred L. Whipple in 1950 had postulated that ice was one of the chief constituents of comets but unfortunately this postulate was difficult to test. Neutral water itself does not give off any characteristic radiation that can be detected by means of optical telescopes. It was surmised however that ionized water (H_2O^+) should give off optically detectable radiation but no one had succeeded in producing its characteristic spectrum in the laboratory and hence in the case of a comet there would be a question of identification. Many attempts had been made over the years both in our

laboratory and elsewhere to get the spectrum of the water ion but success did not come until 1972.

It was in the summer of 1972 that H. Lew and I. Heiber succeeded in obtaining the optical spectrum of the water ion by bombarding low pressure water vapor with electrons. After a preliminary analysis a note was published early in 1973 giving a brief description of the spectrum and some basic structural parameters of the molecule. Interest in the results was quite high among members of the spectroscopic "fraternity" because of the fundamental importance of water and because this spectrum had been so long in yielding to the efforts of scientists. The interest, however, was strictly from a fundamental point of view, from the point of view of spectroscopic theory and molecular structure. In December 1973, however, the picture changed dramatically. Comet Kohoutek had come close enough to the sun for astronomers to take pictures of its spectrum. Herbig of the Lick Observatory, Santa Cruz, California and Benvenuti and Wurm of the Asiago Observatory, Italy found some spectral lines in the radiation from the tail of Comet Kohoutek that they could not identify. Herzberg and Lew learned of these observations and noticed they corresponded to some of the laboratory lines of the water ion. It was not possible to be absolutely certain that they were due to H_2O^+ because only about half a dozen lines were observed and their wavelengths could not be measured accurately. There was a chance of the coincidences being

accidental. However the comet lines did correspond to what one would expect in the laboratory if the water ions were very cold, as they probably were in the comet. This fact made it less likely that the agreement was merely accidental. Accordingly Herzberg and Lew announced that the water ion had been tentatively identified in the tail of Comet Kohoutek and that, if confirmed, the head of the comet was indeed composed of ice as postulated by Whipple. Confirmation came very quickly as Kohoutek approached closer to the sun and more lines were seen by more astronomers. Eventually about 50 lines of H_2O^+ were identified in the spectrum of the comet and a joint publication announcing the fact was put out by Herzberg and Lew and three astronomers, Wehinger and Wyckoff (of Wise Observatory, Israel) and Herbig.

The discovery of water in Comet Kohoutek is considered one of the major discoveries to come out of the considerable scientific effort that was expended on this comet. It is felt by astrophysicists that comets are samples of the primordial material of the solar system and any information about parent molecules in comets may throw light on the formation of the solar system.

In summary then, the story of the water ion spectrum represents one of the more recent successes of this laboratory in its program for the study of ions and molecules of possible astrophysical interest. Such studies provide data not only for astronomers but also for physicists and chemists who are interested in basic molecular processes.

SOMATIC HYBRIDIZATION OF PLANTS

Basic research on the biogenesis of organic compounds in plants was initiated at the Prairie Regional Laboratory in 1955. Radioactive labelled organic compounds were fed to plants to elucidate biosynthetic pathways and the verification was by the isolation of enzymes responsible for the various steps along the route. Yields of enzymes isolated from whole plants were often very low and progress depended on growing uniform plants under controlled conditions. An elegant solution to these problems, conceived around 1963 was to grow the individual cells from plant tissue in the same manner as bacteria and yeasts. Methodology was developed to convert tissue (leaves, stems, roots) into plant cells and grow these in a liquid medium. This successful development opened up a new research area with many potential applications, among which was the growth of plant cells in fermentors to produce valuable compounds such as alkaloids, pharmaceuticals, proteins, amino acids, etc. normally produced by selected plants.

While a limited amount of research was carried out in the above areas, another application was recognized by scientists working on the program. Traditionally, agricultural crops have been improved over centuries by conventional plant breeding and selection involving sexual crossing. This approach is limited to closely related plant species with only a few successes for inter species crosses, e.g. Triticale (wheat

x rye). Steady progress has been made in developing new varieties with improved yield, quality and adaptability to different production areas using world collections of germ plasm (Green Revolution). However, recognition was being given to the law of diminishing returns and around 1969 world authorities including Nobel Prize winner Dr. N. Borlaug suggested that the search for desirable characteristics had nearly exhausted the known potential and advocated the need for the development of a radically new approach.

The scientists working in the plant cell program realized that each cell in a plant contained all the genetic information possessed either by the plant or the seed from which it originated and proposed a new approach to plant breeding. The proposal was to produce protoplasts (naked plant cells) from plant cells and to fuse the protoplasts to produce hybrid cells which would be cultured to form new hybrid plants. Since this system involved vegetative rather than sexual cells it offered the possibility to make crosses between plants widely separated according to family tree. It was obvious that this was a long-term, high-risk proposal, requiring a great deal of fundamental research and the development of new skills and technologies before the system could be tested and applied to practical problems. However, it had been demonstrated that carrot and tobacco plants could be grown from vegetative tissue and progress had been made in producing hybrids of animal cells.

The successful development of this new concept would extend the transfer of specific factors from one plant to another and permit transfers not possible by the conventional methods. One could visualize the transfer of characters such as the specialized root systems of native plants adapted to an arid or semi-arid region to cultivated crops, the transfer of the nitrogen fixing capability of legumes to cereals and the acquisition of resistance to disease and insects.

The inhouse program has advanced over a decade to the status of a major project. Methodology has been developed to remove the cell walls producing protoplasts ("naked cells") which can be induced to undergo fusion producing hybrid cells. The cell walls can be regenerated to restore the protoplast to the status of a plant cell and these cells can be induced to grow and reproduce. A major breakthrough has been a rapid, efficient technique to increase the incidence of fusion which has produced hybrid cells from more than 15 plant genera. Since the fusion of two plant cells introduces all the genetic characteristics from each cell into the hybrid, an alternate approach is under study to introduce single or limited characteristics in the form of the isolated DNA.

The production of hybrid cells is only the first stage of the system. The second stage is to induce the hybrid cell to grow and regenerate a complete plant. Again, a great deal of basic research and technology is required to provide the necessary background knowledge. Cells from different species

require different environmental conditions and growth hormones for plant regeneration.

To date a number of species have been taken through the cycle from plant cells to protoplasts to plant cells and to regenerated plants.

While the main thrust of the research is being directed to cell fusion, genetic transformation and morphogenesis, the latter has had some practical spin offs. A research contract has been completed to produce disease-free Cassava stock (plants of major importance to developing countries of the tropic and semi-tropic regions) which will permit the establishment of a world collection and exchange of breeding material between continents. A second contract is underway to investigate the potential of the system for another practical application in developing countries. More recently a start has been made to eliminate a virus from the world collection of peas that are the basis for development of improved commercial varieties to develop a protein industry in Canada.

When the program was initiated there were about six groups in the world engaged with cell culture research. The effort in this area has expanded and now encompasses laboratories in more than thirty countries involving more than 1000 scientists. At about the time of inception of the present program the Rockefeller Foundation invited twelve scientists to a conference in Italy to assess the potential of plant tissue culture for crop improvement and recommended support. This has been

followed by a second meeting in 1975 which included plant breeders and scientists from developing countries. On the basis of significant progress, the Rockefeller Foundation endorsed the application of the technology. A representative of the research group at P.R.L. was invited to participate in both meetings. This laboratory has maintained a leading world position and staff have been invited to organize and to participate as main speakers in International Symposia and workshops leading to the establishment of new research groups. At least three major agricultural industries in other countries have set up research groups which is taken as a positive indication of both the potential for this new system and the increasing probability for successful practical achievements. Eleven visiting scientists from other countries have spent periods of three months to a year working at this laboratory with financial support from their organizations. Within the last year scientists from six Canadian research organizations have consulted with the staff on setting up research projects.

While much basic research and technology is still required, the progress towards somatic hybridization of plants has been impressive, has won international recognition for Canada and has moved the original concept from the realm of an idea to a real possibility. The decade of basic research has provided sufficient background to delineate areas and now enables mission oriented research organizations to participate in projects having more specific practical objectives.

ANTIGENS OF PATHOGENIC BACTERIA

This project was initiated from within a group as a result of a desire to reorient its research in directions that were more relevant from the viewpoints of both scientific challenge and potential usefulness.

The Carbohydrate Section of the Division of Biological Sciences had been studying plant polysaccharides as long-term, directed research related to problems of pulp and paper and agriculture in Canada. It had established itself at the forefront of research in this field, and was regarded as one of the strongest groups in the world in the chemistry of polysaccharides. The results of some 8-10 years of research showed clearly that there were only a limited number of different polysaccharides in plants. There were major differences between polysaccharides in straws, soft woods and hard woods but practically none between those of individual species within each subdivision. When knowledge about plant polysaccharides reached that stage, the members of the Carbohydrate Section felt that the field had been worked out as a scientific challenge and began to consider a reorientation of their research. The criteria used were (a) scientific challenge, (b) relevance to social or economic needs, (c) suitability to NRC, and (d) need for the very strong expertise in polysaccharide chemistry that had been developed in the section. The area of research chosen was bacterial polysaccharides.

Unlike the plant polysaccharides, there were known to be major differences between the polysaccharides of nearly every species of bacteria in which they had been examined. In fact, polysaccharides frequently constitute the only means of distinguishing between serotypes within a species. It was therefore clear that bacterial polysaccharides would present practically an infinite number and variety of difficult, intriguing structural problems. In addition, there was good evidence from work on a few species that polysaccharides were important immunogenic components of bacteria and were the antigens that gave rise to and reacted with antibodies. The problem of explaining the exquisite specificity of the antigen-antibody reaction in terms of structure has been cited as one of the major scientific challenges of modern biochemistry, and the study of bacterial polysaccharide antigens certainly required the expertise in polysaccharide chemistry; thus two of the criteria were met.

Orientation of our work towards the antigens of pathogenic bacteria seemed to provide for both relevance and suitability to NRC. There have been an increasing number of reports of the development of antibiotic resistance in some species of pathogenic bacteria. When one considers the short generation time of bacteria (ca. 20 min), it is not surprising that natural evolution should lead to resistant forms rather quickly. It is questionable whether or not the discovery of new antibiotics will be able to keep pace with the evolution

of resistance. An effective means of counteracting this situation is immunization with the natural antigens of the bacteria. It has been suggested that immunization with isolated, structurally defined antigens, rather than with killed whole bacteria, might provide more effective and safer vaccines. Certainly the use of isolated antigens can give highly specific antisera that are useful as diagnostic reagents. Thus, a program on isolation of bacterial antigens has both social and economic relevance in terms of public health and production of vaccines and diagnostics.

In terms of suitability for NRC, probably the most important consideration is the interdisciplinary expertise required for this work. The strength of polysaccharide chemistry has already been emphasized, but in addition the program requires microbiologists to select and cultivate the bacteria, physical chemists to assist in structure determination, and a well-staffed animal facility for testing antigens and raising antisera. Quite apart from the difficulties of forming such a group in a university milieu (because it would cut across so many departmental lines), the health-safety precautions necessary to work with pathogenic bacteria would be hard to maintain with attendant risks to the student body.

Because there were no facilities at NRC for the safe cultivation of pathogenic bacteria, the program depended initially, and to some extent still does, on collaborations with scientists elsewhere who were able to culture pathogens.

In addition, the group worked on some related but non-pathogenic bacteria to learn techniques and to acquire the requisite expertise in immunochemistry and serological methods.

The pathogenic organisms under study have been, dermatophytic fungi, several Pneumococcal serotypes, Pseudomonas, N. meningitidis and N. gonorrhoeae. Work on the dermatophytic fungi has been completed; structure-serological activity relationships were established for the polysaccharide antigens of some 16 different fungi and the potential usefulness of these compounds as diagnostic agents was demonstrated. Studies of Pneumococcal serotypes are continuing. This bacterium has been showing signs of developing antibiotic resistance and immunization of susceptible segments of the population has been initiated in the U.S.A. There have also been sporadic but severe epidemics in other parts of the world caused by serotypes not previously implicated in the disease. The structures of only a few of the specific polysaccharide antigens are known and methods of isolation and purification are poorly understood. The Pseudomonas are highly infectious bacteria, resistant to antibiotics, and of major significance in hospital-acquired infections and in veterinary medicine. Dr. M.B. Perry, of this group, has shown that the polysaccharide antigens are serotype specific and can be used to generate specific typing sera for diagnostic purposes. A diagnostic services industry (MDS Ltd.) is in process of incorporating this diagnostic system into its services.

N. meningitidis, the causative agent of meningitis, has at least six known serotypes and is not very susceptible to antibiotics. Dr. H.J. Jennings, of this group, has isolated and characterized the polysaccharides of each serotype and shown that they are the serotype-specific antigens. This marks the first time that a complete serotype classification has been explained in terms of polysaccharide structure and the work won for Dr. Jennings the Harrison Prize of the Royal Society of Canada, an award given for a significant advance in fundamental microbiology. During the course of this work Dr. Jennings also found another antigen that was common to all six serotypes. Tests of this antigen in an animal model of the disease developed by Dr. P. Kenny, Laboratory Centre for Disease Control, indicated that it was a protective antigen for all serotypes. Development of this antigen as a possible vaccine for meningitis is being transferred to industry (Frappier Institute) by means of a contract.

Studies on the antigens of N. gonorrhoeae, by Dr. M.B. Perry in collaboration with Dr. B. Diena, Laboratory Centre for Disease Control, have shown that specificity resides in the side chains of lipopolysaccharides and that these are different for different isolates. These results indicate that this bacterium has many strains, a possible explanation for the apparent absence of acquired immunity after exposure. However, the work also showed that the central part of the lipopolysaccharide (i.e. without side chains) was common to

every strain but was specific for the species. Thus, the "core" portion of the lipopolysaccharide was a specific antigen for N. gonorrhoeae and could be used to raise specific antiserum for diagnostic purposes. A diagnostic services industry (MDS Ltd.) has placed its own employees in Dr. Perry's laboratory to learn the technology of lipopolysaccharide isolation and antiserum production with a view to incorporating the specific diagnosis of gonorrhea as one of its services.

This project is an excellent example of the difficulty, if not impossibility, of distinguishing between "applied" and "basic" research in the life sciences. While the project is categorized as "applied", the objective is to discover the relation between the immunological specificity of bacterial antigens and their structure. This involves research into culture methods for bacteria, isolation and purification of antigens, and tests of immunological specificity and activity. All of this must be done before any application is practical. Thus, the work in the project has won an award for "fundamental microbiology" and, at the same time, has attracted the close collaboration and transfer of technology to two commercial companies.

THE NRC PRIMARY CESIUM CLOCK (CsV)

Although the philosophical meaning of time may represent an almost insoluble problem, the physical generation of time scales by the accumulation of time intervals of almost identical duration, fixed by the physical constants of atoms, has attained a very high level of development during the past 20 years. This very precise construction of time scales can be accomplished by a number of different devices, but the one which has been internationally accepted as providing the most reproducible time scale is the cesium clock.

The most exact cesium clocks, the so-called long beam primary laboratory cesium frequency standards, are large and complex devices several meters in length and weighing a ton or more. Only a few of them have been constructed in the larger national laboratories, and they have all suffered from an inability to operate continuously for longer than a few hours or days.

Smaller, much less exact clocks, about 5% of the size and weight of these large devices, have been extensively developed commercially. The tendency has been to use large groups of these to generate a time scale, on the assumption that the mean clock rate would provide a much more exact and reliable scale than any of the individual clocks. The rate of this mean scale can then be calibrated by means of a long beam primary laboratory standard if one is available. However, despite their smaller size, these commercially produced clocks

are almost as expensive to construct and more expensive to maintain than the larger laboratory instruments.

The new NRC 2.1 meter primary cesium clock (CsV) constitutes the first successful attempt to combine the best features of both types of instruments. Its accuracy equals or exceeds that of the best long beam standards developed by other countries, and for continuous operation the timing error of less than 3 millionths of a second per year is less than that of any other instrument. Except for several very brief interruptions for checks of its operation, it has functioned continuously since May 1, 1975, and has provided the longest and most exact measurement yet made of the rate of the International Atomic Time Scale maintained by the Bureau International de l'Heure. This scale is based on the weighted mean of a total of about 60 commercial atomic clocks located in laboratories and observatories throughout the world, and intercompared by radio methods to precisions of the order of a few ten-millionths of a second.

In addition to these international commitments and contributions, it has been possible, because of the flexibility of the design of CsV and its excellent stability, to carry out a series of cooperative scientific experiments with the Laboratoire de l'Horloge Atomique of the University of Paris under the auspices of the NRC-CNRS cooperative agreement on scientific research.

Development of this new clock has benefitted Canadian industry in at least two ways. Construction of the large stainless steel vacuum tank by Dominion Welding Engineering to NRC specifications has aided in the development of Canadian industrial expertise in the area of high-vacuum technology. Also, CsV as a continuously-operating time standard now makes possible simple, rapid, exact, and inexpensive calibrations of clocks and frequency standards for the industrial community.

From the point of view of economy of operation, initial experience with CsV has demonstrated that (in contrast with time-keeping procedures adopted in other national laboratories which require groups of up to 20 \$20,000 commercial clocks) only two or three such clocks will be necessary in future at NRC to bridge the brief periods when CsV is inoperative. In addition, the cost of component parts for CsV was less than twice the cost of present commercial standards. Maintenance costs, because of its readily demountable design, are expected to be negligible.

Possible future benefits to Canadian industry may result from application of the experience gained with CsV to the development of smaller prototype clocks which would have a potential for Canadian manufacture for the international market. Such clocks could satisfy the growing requirement for the very high timing accuracy necessary in navigation and aircraft collision avoidance systems.

Present development work in the United States and Europe is directed toward adapting present commercial atomic clocks for satellite use, and it is possible that the NRC type of standard with its higher accuracy would meet the more stringent requirements of ground control stations.

The achieved accuracy goal of a few millionths of a second per year also has very real practical applications in the area of high-speed digital data transmission where superimposed messages, coded only by timing procedures, must be "unscrambled" at the receiving terminals. Although a primary clock such as CsV would not form part of the data transmission system, monitoring of the digital data rates with respect to it would constitute a valuable service. Indeed, monitoring of the digital data rates of the Bell Data-Route system with respect to CsV has already started, at the request of Bell Canada.

MECHANISMS OF OUTDOOR SOUND PROPAGATION AND
INSULATION OF DWELLINGS AGAINST EXTERNAL NOISES

In recent years the rapidly growing public concern about noise and the large amounts of money involved in either noise control or damage suits have enhanced the need both for a more precise understanding of the mechanism of outdoor sound propagation and also for effective, simple, and economic means of insulating dwellings from outdoor noise sources. The NRC Laboratories have tackled these different, but complementary, problems as two distinct projects.

Mechanisms of Outdoor Sound Propagation

A comparison of predicted and measured urban noise levels, started in the Division of Physics in 1968, brought to light a serious error in the accepted theory of atmospheric sound absorption: the failure to take into account the vibrational relaxation of the nitrogen molecule. This was shown to be the principal absorption mechanism for frequencies below 1000 Hz which are predominant for aircraft and community noise. (The knowledge crucial to the solution of this practical problem was acquired in an unrelated project of the division's acoustic section: the study of ultrasonic relaxation processes in liquids of interest to chemists.) As a result of this work, the national and international standards concerning the attenuation of airborne sound have been completely revised under NRCL leadership to include the effect of the nitrogen relaxation and are now awaiting official approval.

It soon became apparent that many other aspects of sound propagation outdoors were equally in need of re-examination. For example, it has been shown recently that the finite acoustic impedance of the ground, atmospheric turbulence and land contours are highly important over distances (10 m to 10 km) that are relevant to urban planning. Our current picture includes a protective acoustic shadow zone near the ground that at times is almost ubiquitous but which can be easily lost with poor acoustic design and under adverse meteorological conditions.

The quantitative influence of finite ground impedance and the effects of weather and topography have been demonstrated in a study of the noise levels around Vancouver Airport undertaken for the Department of the Environment, which is intended to serve as a model for use elsewhere. This showed explicitly, for the first time, that noise levels were predicted to be higher for listeners on hillsides than on flat land; this finding was in good accord with the complaint structure of residents in these locations. This improved correlation between theory and complaint patterns should lead to increased acceptance of the validity of environmental impact forecasts for new or modified use of a highway, airport, factory, etc.

The mechanisms of sound propagation which determine the penetration of sound into the community are also of basic concern in the formulation of, and the testing of conformity to, legislation of noise limits for individual motor vehicles.

Thus the impedance of the ground (snow) surface has been found to exert a major influence on the levels of noise measured from snowmobiles during standard tests, and a study for the Ministry of Transport has demonstrated the effect of atmospheric fluctuations of wind and temperature on the sound levels measured using the standard test procedure for road vehicles.

Insulation of Dwellings against Outdoor Noise Sources

Around every major airport there is an intermediate zone where outdoor noise is tolerable, but where special construction is needed to bring indoor noise down to acceptable values for sleeping and leisure-time activities. To delineate this intermediate zone and to devise practical rules for dwelling construction within it, a joint project was organized with the Central Mortgage and Housing Corporation and Transport Canada. Noise exposure forecasts, based on currently used prediction methods, were provided by the Ministry of Transport. The role of the Division of Building Research was to devise simple rules for defining the required sound insulation and to provide a "catalogue" of adequate constructions for various noise zones.

The first edition of these guidelines, published in 1972, was based mainly on experience with indoor sound insulation problems, and it was recognized that the detailed pattern of incidence of aircraft noise on the exterior of a building was not accurately known; nor was the performance

of some external elements of buildings such as windows, doors and roofs. These points have since been investigated in an experimental building provided by CMHC on an approach path to Ottawa airport: subsidiary laboratory tests were also done to provide a link with standard sound insulation tests, and hence a continuing basis for assessment of new building components. In terms of building construction, the results involve mainly the intelligent use of existing technology with emphasis on the performance of windows. One consequential requirement is alternative means of ventilation or air conditioning. The extra cost per dwelling unit in high noise areas is estimated to be between two and three thousand dollars. For directionally defined sound sources, such as traffic noises, the guidelines take account of optimum orientation and internal planning of the building, thus leading to the most economical way of achieving an acceptable indoor noise environment. These further results have been incorporated in a revision of the CMHC guidelines for aircraft noise, and similar guidelines for land use near major roadways and railways.

In summary, the outcome of these related projects has been the reliable prediction of noise levels that correlate well with the listening experience of the public under varied topographical and meteorological conditions, and the provision of a firm basis for standards and regulations promulgated by

government agencies. In addition to outdoor noise considerations, guidelines indicate the most effective and economical ways of providing sufficient sound insulation to give acceptable indoor living conditions.

* * * *

DURABILITY OF BUILDING MATERIALS

Canada suffers a major economic loss every year in the repair and maintenance of buildings. Currently it is estimated that the annual cost of repair and maintenance is about \$5 billion, 25 percent of the cost of new construction itself. Deterioration of protective coatings from pollution alone is estimated to amount to about \$100 million annually. Deterioration of even the basic building materials, concrete, brick, stucco, etc., continues to occur despite the fact that these have been used for hundreds of years. The inability to predict such failures and thus avoid them can be attributed to the limited knowledge of the basic nature of the materials and the lack of understanding of the various processes involved in deterioration.

It was recognized in the Division of Building Research that improvements in the durability of building materials required a concentrated effort by an interdisciplinary group concerned primarily with the basic factors affecting their

performance. This required the development of specialized scientific expertise committed to long-range studies of the processes of deterioration.

It was recognized that water plays an important part in most deterioration processes such as corrosion of metals, freezing destruction in porous materials, and the weathering of organic materials. It is also an agent causing instability in materials due to swelling on wetting and shrinkage on drying. Hence, much research was devoted to the study of the interaction of water with materials.

Cracking of materials due to drying shrinkage is a common experience. The process of dimensional change due to wetting and drying of porous materials, such as hardened cement in concrete, was investigated very thoroughly. It was discovered that part of the water lost in drying was in fact contained in the structure of the layered system and accounted for the large shrinkage. This information led to the formulation of a new model of hydrated cement serving as a tool for understanding and predicting the behaviour of this material.

Destruction of concrete, brick and stone by frost action in the severe climate of Canada is well known to all Canadians; and yet this process was not understood. Basic research on this question for several years yielded a significant level of understanding which showed that under freezing conditions a piece of concrete behaves in much the same manner as a piece of carrot or potato. There is a

definite link between cryoinjury (the destruction of biological material during freezing) and damage that can occur when porous inorganic materials containing water are frozen. This understanding of the freezing process is now being exploited to produce a more durable concrete, for which an application for a patent is being made. A method has also been developed for evaluating brick for resistance to freezing damage which is now being considered by the industry as a quality control in the manufacture of brick.

Although some organic-based materials, such as wood, bituminous materials and various protective coatings, have a long history of use in construction, several of these materials, e.g., plastics, are of very recent origin. Many problems experienced with these materials are related to the lack of knowledge of their basic properties on the one hand, and lack of understanding of the process of deterioration on the other. This situation is similar to that described above in connection with inorganic building materials. Concern about the inability to predict long-term performance of a given paint from short-term tests or from measurements of its basic properties has prompted studies to provide the basis for such prediction. Weather factors, such as solar radiation, duration of surface moisture and surface temperature, are being measured along with degradation of various materials to provide an understanding of the degradation mechanisms and a more rational basis for accelerated tests.

In this connection, a recent study has revealed the mechanism of failure of glass-reinforced polyester sheet material, now used in exterior cladding and autobodies, when exposed to outdoor weathering. Two processes were identified: one involves a fatigue failure of the glass fiber to polyester bond, induced by cycles of temperature and moisture, the other involves surface micro-cracking of the resin induced by ultra-violet light in solar radiation. This knowledge will help manufacturers to evaluate quickly any newly developed material in this class from the standpoint of long-term performance.

The expertise acquired to develop knowledge of the materials, and their behaviour under various conditions of service, can be exploited in the development of more durable materials for severe conditions of use, such as repair of materials. Patent application is being explored for recent development of a repair material for pot-holes involving a composite made from fiber-reinforced asphalt-sulphur composition.

The cases cited above are contributions to science-based knowledge that have not only been recognized by the science community, but have also resulted in advances in the technology of manufacture, testing, and evaluation of the performance of building materials. This contribution is certain to result in a significant economic benefit from reduced cost of repair and maintenance of building materials. Much more can be achieved by exploiting the existing core of expertise on building materials.

COLD REGIONS ENGINEERING RESEARCH

When the Division of Building Research was established in 1947 it was recognized that there was a need for engineering information on permafrost, ice, and snow for construction and development activity in northern Canada. Research on these materials was initiated with the objectives of developing the knowledge base required for sound engineering practice and a source of expertise that could respond to requests for information concerning solutions to northern engineering problems. Particular attention has been given to field investigations of the performance of foundations and structures in permafrost, the distribution and characteristics of permafrost, strength and deformation properties of ice and snow, field investigations of the bearing capacity of ice covers and the effect of ice on structures, and the characteristics of avalanche and avalanche defence systems.

With the discovery of petroleum in Alaska, there was a sudden increase in demand for information on the properties and characteristics of permafrost. The permafrost research group of the Division of Building Research was, initially, the only activity of its kind in Canada that was able to respond to this demand. Although the Division had only a total of three professionals working in this problem area, they were able to draw on more than twenty years of investigations to provide very significant and useful guidance and advice to private companies and government agencies that now

had to learn to construct and operate on a much larger scale in the north.

One example is assistance given to Mackenzie Valley Pipeline Research Limited in the planning, instrumentation, observation, and analysis of a test facility to evaluate the performance of a hot oil pipeline near Inuvik, NWT. The Division provided space and technical supervision to the company for the development of techniques for measuring the properties of thawing permafrost, and for carrying out measurements required for the analysis of the observations. Through support provided by the company, equipment and procedures were developed for measuring thermal conductivity of frozen soils both in the laboratory and in the field. The capability developed in this project has since been used to measure (for the Institute for Guided Transport at Queen's University) the thermal conductivity of frozen ores and coal. This information was required by the Institute for an investigation carried out for industry on freezing of ores and coal in railway cars. Similar measurements of the thermal conductivity of frozen and thawed soils were made for the Department of Indian Affairs and Northern Development in connection with the design of the Mackenzie Highway.

A second example is the role the Division has played in an inter-departmental investigation of the use of insulation for preserving permafrost beneath roads in the north. In many northern areas there is a severe shortage of suitable

fill material for highway construction, particularly when the fill must be of sufficient thickness to prevent the thawing of underlaying permafrost. Insulation may be one practical solution to the problem. The Division designed an appropriate field test program, developed the instrumentation required, supervised the installation of the instrumentation and construction of the test road, and is presently making the observations of performance and analyzing the results.

In the winter of 1973-1974, Panarctic Limited submitted an application to the Department of Indian Affairs and Northern Development for permission to construct an offshore ice platform for drilling a delineation well near Melville Island, NWT. The Department asked the Division to assist it in checking out the design and in carrying out the observations necessary to ensure that it performed in a safe manner. The Division was able to provide this assistance based on the expertise that it had acquired. It performed a similar service for a second well in the winter of 1974-1975. Through this participation the Division was able to ensure that the experience gained by Panarctic Limited and its consultants on this activity was properly recorded, in addition to making a significant contribution to the development of design procedures for this unusual use of ice covers. It is estimated by Panarctic Limited that being able to drill wells from ice platforms has brought about the saving of

several millions of dollars. Three wells are to be drilled from ice platforms in the winter of 1975-1976. The technique has now been sufficiently developed that future monitoring activity can be carried out on a more routine basis by departmental and industrial technicians.

In 1974 the Division was asked by the Department of Public Works and the Ministry of Transport to assist in evaluating the design and performance of a wharf constructed for a mining development in a joint government-industry project at Strathcona Sound on northern Baffin Island. The Division developed and installed instrumentation to monitor ice pressures and other parameters at this structure and is analyzing the observations being made. The results of this study will provide much needed information relevant to the establishment of shipping facilities in the far north.

The Division of Building Research is recognized, both nationally and internationally, as a prime source of information and expertise on not only applied but also basic research aspects of cold regions engineering. It has gained this reputation as a result of studies (conducted in the laboratory and the field over the past twenty-five years) to provide basic information on the properties of frozen ground, snow and ice, and on the occurrence and distribution of permafrost. Staff members have also organized or participated in many national and international symposia and conferences dealing with these topics and applied northern engineering.

It is anticipated that expenditure by government and industry on the development of national resources and the associated necessary infrastructure will exceed several billions of dollars in the next few years. Information obtained and disseminated by the Division will help to improve the design and construction process. Benefits gained by constructing in a proper and safe manner will be reflected economically and socially in providing the desired quality of life in this region of Canada.

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FIRE RESEARCH ACTIVITIES

The degree of fire protection in buildings is in general determined by the provisions contained in building and fire codes. The construction industry is obviously affected by such provisions. To assist those concerned with building fire protection, the Division of Building Research operates a well equipped fire research facility. The staff of this facility has over the years developed expertise in many areas of fire protection. These include the fire resistance of building materials and assemblies of building materials, surface flammability of lining materials, gaseous products produced when materials burn, fire behaviour in compartments, and smoke movement and its control. Advice is available on a continuing basis to authorities concerned with the development of fire safety regulations and to the construction industry.

The problem created by the vertical movement of smoke through a building during a fire was brought dramatically to the attention of the Committee on the National Building Code by a fire in the ground floor restaurant of a tall Montreal hotel in which smoke moved rapidly into upper floors by way of elevator shafts and stair shafts.

As this event could be readily understood in the light of studies carried out on stack effect which produces other problems in buildings, a joint project was introduced including members of both the Fire Section and the Environmental Section of the Division of Building Research.

Provisions intended to improve safety to occupants by controlling, among other things, smoke movement, were introduced into the National Building Code. The Division of Building Research participated in the preparation of a supplementary document to the National Building Code which includes typical fire safety systems that can be incorporated in a building in order to meet the requirements of the Code. Designers and building inspectors have had frequent meetings with staff members in order to discuss the implementation of these measures in proposed buildings and visits have been made to resulting completed buildings to study the effect of the measures.

The National Building Code describes fire performance of building elements by reference to certain standard fire

tests. The Division of Building Research has provided needed information by conducting standard fire tests and by the study of test reports from other sources. A companion document to the National Building Code, Supplement No. 2 Fire Performance Ratings, has been developed by the code committees with the technical assistance of the Fire Section. This provides ratings for a wide range of generic materials and assemblies that are covered by standard specifications.

Tests carried out at the Division of Building Research have improved the information base, with the result that ratings have been refined and economies achieved. For example, a study of the factors in the fire performance of reinforced concrete columns carried out jointly by the Fire Section and Building Structures Section has resulted in improved understanding of the behaviour of these columns in fire. The performance of concrete and hollow concrete masonry walls was also the subject of an intensive study which allowed more precise figures with resultant economies in materials to be obtained for use in Supplement No. 2.

The advent of new materials or variations of materials has created hazards that have called for new tests for their evaluation. Towards the end of the last decade, incidents were reported in which carpets played a major role. In the extreme, fire propagated rapidly along corridors in which carpet was

the only combustible material present. The hazard was judged similar to that assessed by the ASTM E84 Tunnel Test for ceiling and wall lining materials. It was found that for many materials the rate of propagation was of the same order whether a specimen was mounted on the ceiling or on the floor. It was therefore concluded that the ASTM E84 Tunnel Test was also valid for floor coverings. The test was first incorporated into the National Building Code and then adopted as a CSA (now ULC) standard.

The use of plastic light diffusers and ceiling lighting panels poses a hazard because the most suitable materials are quite highly flammable. It is submitted by manufacturers that as generally used, the diffusers and panels would fall out of their ceiling mountings before contributing to a fire and that the same material burning on the floor would present a reduced hazard. The tunnel used in the ASTM E84 Test was adopted to provide a "drop-out" test indicating whether or not a product would fall out before becoming involved in fire. The test has been referenced in the National Building Code and it is likely to become a national standard.

The appearance of plastic foam in the building field has created problems regarding the assessment of its flammability. Hitherto, materials described as highly flammable have shown both rapid and extensive fire propagation. Unfortunately, the

relationship between rapidity and extent of travel is not the same for both plastic foams and more conventional materials. This has created fundamental difficulties in the assessment of the hazard which will require considerable study before the problem can be resolved. The Division of Building Research is currently conducting appropriate studies and is cooperating with the U.S. National Bureau of Standards with regard to some aspects of the problem. In the meantime, many authorities have recommended that foam plastic be covered and the National Building Code has adopted this policy. To implement these provisions, standards for covering foams and for assessing the hazards of foams within cavities must be developed. The Division of Building Research has developed two tests in this field that are currently being considered by the ULC Fire Test Committee.

Industrial Fellowships

The Division of Building Research has developed an arrangement whereby an industry or an industrial association can support a Research Fellow working in the Division's laboratories. Industry provides the salary for the Fellow and the Division provides technical and administrative support and the use of its facilities. Very successful programs have been carried out, for example, with the National Concrete Producers Association and the Canadian Institute for Steel Construction.

The National Concrete Producers Association fellowship program resulted in a large number of fire endurance tests of hollow concrete masonry. This enabled improved ratings to be developed for Supplement No. 2 of the National Building Code and the possibility of taking into account several significant variables that previously had been neglected. Changes due to the addition of sand to lightweight aggregate concrete, the filling of hollow cores and the addition of gypsum board over the surface of concrete block walls were measured and rated.

Fire endurance tests carried out under the Steel Fellowship program have resulted in improvements in some ratings in Supplement No. 2 relating to membrane protection of steel floors and beams. Tests and study of the performance in fire of steel columns resulted in the development of formulae relating mass of steel and thickness of protective covering to fire endurance. This has introduced economies in fire protection of steel columns. In addition, the combination of sheet steel and an insulating lining has been accepted as a means of obtaining a desired fire resistance. These have the advantage of dry installation, the possibility of prefabrication and of providing some protection against physical damage.

Over 75% of new residential construction in Canada is influenced by the National Building Code. This activity has an annual value of about 12 billion dollars. It is clear that results of research that bring about significant changes

in the Code, particularly those that result in reduced cost of construction, will have a desirable beneficial effect on both safety and the national economy.

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DEVELOPMENT OF TUBULAR MEMBRANE TECHNOLOGY
FOR REVERSE OSMOSIS APPLICATIONS

Reverse osmosis is a general process for the separation of substances in solution. The process consists simply in letting a solution flow under pressure through an appropriate porous membrane; depending on the membrane material and its surface porosity, the solute is partly or completely retained on the upstream side of the membrane, yielding a membrane-permeated product enriched in the solvent. The process has become practically significant since the development in 1960 of a successful technique for making highly productive porous cellulose acetate membranes for water desalination. In view of the obvious potential of reverse osmosis for many industrial applications, a program of basic and applied research was started in 1961 in the Division of Chemistry to explore reverse osmosis in all its aspects.

This research program was concerned with the factors governing reverse osmosis separations, choice of membrane materials and membrane-making conditions, and the development of appropriate technology for bringing reverse osmosis into industrial practice. This program has already opened a

series of possible practical applications for the reverse osmosis process. It has been demonstrated that the process is applicable to the entire field of domestic and industrial water treatment including water purification, water pollution control, water renovation and reuse, and waste recover. The process is also applicable to:

- The production of ultrapure water needed for electronic industries,
- The concentration and fractionation of heat-sensitive solutions involved in food-processing and pharmaceutical industries,
- Hydrocarbon separations and fractionations involved in petroleum industries,
- Gas separations involved in the recovery of helium from natural gas,
- The control of atmospheric air pollution resulting from industrial gaseous effluents.

Continuation of this research program is expected to result in the evolution of appropriate practical membrane systems for all the above applications of reverse osmosis, and also make a significant contribution to many other areas of science, engineering, and medicine.

Porous cellulose acetate membranes are particularly effective for many water treatment applications. For this reason, the above class of membranes were studied in detail.

As a result of these studies, the major factors controlling the surface pore structure of membranes during the process of making them were recognized. Consequently, several improvements in the technique of making flat cellulose acetate membranes were accomplished, yielding more productive and more uniform membranes for practical use. These improvements were incorporated in a patent application in 1970. Immediately thereafter, work started on the development of a similar technique for making seamless tubular cellulose acetate membranes. The interest in tubular membranes arose from the fact that they could be cleaned easily and frequently without damage to the membrane surface - a fact of considerable practical importance in the choice of reverse osmosis for the treatment of industrial waste waters contaminated with suspended and colloidal impurities which tend to deposit on the membrane surface. By early 1972, a successful technique for making tubular cellulose acetate membranes was developed, and a patent application for this technique was filed.

During 1971-72, Electrohome Ltd., Kitchener, Ontario, was considering new ventures as part of their diversification program. The potentialities of reverse osmosis for desalting water for their humidifiers, and for general industrial water pollution control attracted their attention. At that time there was no company in Canada engaged in reverse osmosis technology. Therefore Electrohome became seriously interested in the field of reverse osmosis equipment manufacture for

various industrial applications. They were planning to obtain cellulose acetate membranes for their equipments from a foreign source which however soon became unavailable. It was at this time (Fall of 1972) that they came to know of NRC developments in membrane technology at one of the trade shows of Canadian Patents and Development Limited. An Electrohome representative visited NRC Laboratories for a few days after the show to learn more about the details of NRC technology for making tubular cellulose acetate membranes. As a result of this visit, Electrohome decided to enter the field of reverse osmosis, use NRC technology for making tubular membranes, and manufacture their own membranes and modules for reverse osmosis applications. By December 1972, Electrohome had established a separate department for the reverse osmosis venture, and assembled the necessary staff to get the program started.

Active cooperation between NRC and Electrohome in the field of reverse osmosis began in January 1973. The tubular membrane technology was transferred to Electrohome laboratories early in 1973. With frequent consultation with NRC staff, and assisted by NRC's Industrial Research Assistance Program, Electrohome developed their own modules and expertise in membrane manufacture, equipment design, construction, operation, and maintenance. After the necessary laboratory and field experience with different industrial waste waters, they entered into a formal licensing agreement with Canadian Patents and

Development Limited, and began to market their own tubular reverse osmosis membrane modules and auxiliary equipments for industrial water pollution control applications.

In December 1974, Electrohome expanded their staff and facilities and established a full division for reverse osmosis engineering. Their equipment is already in the market for the treatment of radioactive wastes, nickel plating wastes, and oily waste waters. They also have their equipment under long-term field tests for the treatment of waste water effluents from food-processing industries.

Early in 1975, Electrohome felt the need for increasing the production efficiency of their membrane-making unit. In response to this need, NRC developed a new technology which increased the production efficiency of the membrane-making unit 5 to 10 fold compared to the earlier technique. After a preliminary disclosure to Canadian Patents and Development Limited, the new technology was put into operation at Electrohome in December 1975. Electrohome is currently using this new technology for their membrane manufacture.

The reverse osmosis venture is growing at Electrohome. Building on this venture, Electrohome expects to get firmly established in all aspects of domestic and industrial water treatment within the next 5 years.

In terms of water treatment application alone, the social relevance of reverse osmosis is second to none. In terms of all its industrial potentialities, reverse osmosis research can be expected to yield significant economic benefits to Canada.

POLICE SCIENCE AND POLICE EQUIPMENT

The National Research Council has a long record of projects with legal implications, carried out in association with police forces and government agencies. These have included consultations and examinations; research projects carried out on request; the preparation of codes, regulations, or legislation; and accident investigations. The time involved has ranged from the duration of a telephone call to approximately 15 man-years for the DC-8 crash at Ste. Thérèse on 29 November 1963. In March 1969 the Canadian Association of Chiefs of Police (CACP), in their Brief to the Senate Special Committee on Science Policy, recommended that "an appropriately constituted Canadian council of law enforcement science and technology be constituted as a matter of national urgency." The Science Council of Canada, in its Annual Report for 1969-70, supported the CACP and said that "As an example of an urban problem which gets little attention from science and technology, there is the problem of administering law in our cities. There is much modern science and technology available which is not being effectively used in support of law enforcement mechanisms and in the prevention of crime".

These recommendations encouraged NRC to start studies directed towards assisting law enforcement in general and police forces in particular. The work has included two closely related projects, both carried out in close association

with the CACP and its member forces.

In the Division of Electrical Engineering, a group of scientists is carrying out research on the allocation of patrol cars. Since its formation, the group has worked with four police forces from different parts of Canada and has gained an international reputation. The practical object of the research is to optimize the allocation of radio patrol cars both throughout the area they cover and by time of day. Since 24-hour operation of a single car may cost over \$100,000 per year, the potential savings are great. Also since the chances of catching certain offenders depend on the speed with which an officer can reach the scene, the proper positioning of patrol cars may improve arrest rates. The group's main research tool is the computer, which is used in simulations of the police force's patrol operations. It allows experiments to be done rapidly without the expense or morale problems of changing a real force many times. The group has also obtained results of practical interest, including the probability distributions of patrol car speed and of the rate of calls for service at police headquarters. Work planned includes the display of police information on maps on a TV screen aided by computer calculations. This should be valuable both for daily operations and executive planning.

The second project concerns police equipment. Much of the equipment purchased by police departments was originally designed for purposes other than law enforcement, and is

accepted only because there is no other choice. Few police forces are large enough to employ specialists in product evaluation, and few standards or specifications have been prepared. In order to remedy this situation, representatives of the NRC and the CACP, assisted by representatives from the Ministry of the Solicitor General, the Department of Justice and the Department of National Defence, set up a secretariat within NRC and organized the NRC-CACP Technical Liaison Committee on Police Equipment (TLC). At the same time, formal liaison was established between NRC and the U.S. National Bureau of Standards' new Law Enforcement Standards Laboratory. The TLC has held meetings since January 1975 and has undertaken to write specifications and guidelines on police equipment for publication and distribution to Canadian police forces. The first edition of the Procurement Guide for Police Equipment - a Compendium of Specifications - will be released in January 1976 and revisions are planned every six months.

The work of the TLC is largely carried out through Technical Sections. These cover the following fields: burglar and security systems; chemicals; communications systems; dress; electronic devices; emergency and rescue equipment; firearms; investigational equipment; personnel protection; training equipment; working aids; and vehicles. Experts from NRC, police forces, and other agencies are included in the Technical Sections. Task groups for some studies have been

set up, and needed research or testing is carried out by NRC. The design of future equipment should therefore be greatly aided by the TLC.

While the police science and police equipment projects are relatively new they have already produced substantial benefits. The patrol allocation project has not only resulted in improved allocation but has led to the production of mapping and information systems in daily use by police forces. The TLC has given advice on faulty equipment, for example on recently developed bullet-proof clothing, which has saved not only money but possibly lives as well. Benefits may be expected to increase in the future.

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MIRAMICHI CHANNEL (N.B.) STUDY

In 1973 the governments of Canada and New Brunswick received the report of the Northeast New Brunswick Transportation Study by Lalonde, Valois, Lamarre, Valois and Associates, which contained the recommendation that "in-depth hydraulic and ecological studies be made of the technical aspect of dredging the Miramichi River to 26 ft." Increasing the depth of the Miramichi Channel from its present 20 ft to 26 ft would significantly affect the future of the ports of Chatham and Newcastle. The cost of shipping by sea through these two ports is high because of the limited draft, presently available in the

Miramichi Channel, necessitating either the use of very small vessels, or only partly loaded larger vessels. The two ports handle close to 1,000,000 tons of cargo annually.

As a direct result of the above recommendations, an intergovernmental-interdepartmental steering committee was set up in 1974 and subsequently the "Canada - New Brunswick Subsidiary Agreement - Miramichi Channel Study" was signed on February 17, 1975 by the Minister of Regional Economic Expansion and the Premier of New Brunswick. The following departments are participating in the Miramichi Study:

- Federal: National Research Council of Canada
 Transport Canada
 Department of Public Works
 Department of Regional Economic
 Expansion
 Environment Canada
- Provincial: Department of Economic Growth
 Department of Tourism and Environment

The three main components of the study are:

- a hydrographic survey of the Miramichi Estuary,
- a large hydraulic model of the Miramichi Estuary,
- an environmental impact study.

The direct cost of the study, estimated at \$600,000., is financed collectively by the participating departments and agencies. All indirect costs (labour and overhead) are absorbed by each department.

The involvement of private industry in the study has been substantial; the hydrographic survey of the estuary was carried out by Comdev Marine, a \$300,000 contract, financed by the Department of Regional Economic Expansion, administered by the Department of Supply and Services and supervised by Environment Canada and the National Research Council of Canada. The environmental impact study is being carried out through small contracts to several companies, with a total contract price of \$100,000 paid by the Department of Public Works, Transport Canada, and the Province. The entire study is managed by a private consultant, under contract with the Department of Public Works.

The National Research Council of Canada's share of the study is estimated at \$200,000. The direct cost of the model study, \$80,000 is paid by Transport Canada.

The model study is being done at the National Research Council of Canada because of its unique facilities and expertise. This large salt water model (100 ft wide and over 300 ft long, to a scale of 1:800 could be built and operated within a relatively short time span. The project will be completed by July, 1976.

The model study will determine the engineering and ecological feasibility of deepening the Miramichi Navigation Channel to 26 ft. It will define the location of spoil grounds to dispose of the dredged material in such a way as

to minimize future maintenance dredging and to protect the ecology of this estuary, where the fishing industry is of vital importance.

With the increased draft, the ports of Chatham and Newcastle will be expanded, to accommodate larger vessels (reconstruction estimated at 4 million dollars) and new facilities, including a paper shed of 27,000 sq. ft will be built.

The economic and social benefits of this study are obvious. If the channel had been dredged without a model study, it could have led to serious damage to the ecology and therefore the fishing industry and future maintenance dredging could not have been minimized.

While the study is very much concerned with applied research, there is a number of basic research problems. First of all there is the problem of modelling salinity mixing in estuaries, which is becoming of interest not only in Canada but in many other countries. This is only the second salinity model study in Canada, both done at NRC. Secondly, the sand in this estuary is supplied by littoral drift along the New Brunswick coastline, brought into the estuary by the tidal currents. The theory of sediment transport by littoral drift currents is still in its infancy and there is great interest in this type of project, where predictions based on calculations and model studies can be verified in the future.

INDUSTRIAL AERODYNAMICS

The extensive wind tunnel facilities at the National Research Council were originally developed to provide the tools of aerodynamics research and development for the Canadian aircraft industry. This policy dictated the sizes and types of wind tunnels, and required that they be supported by elaborate instrumentation, data processing systems and a complement of professional expertise. The investigative capability concentrated in these facilities is unequalled elsewhere in Canada and by few other establishments in the world. While the NRC wind tunnels continue to be heavily used, on a contractual basis, by the domestic aircraft companies, they have attracted more and more use by American, Swedish, U.K., and other foreign aircraft companies. A by-product of these activities has been a healthy exchange of research information at both a national and international level.

Over the past ten years it has been possible to expand the role of the low speed tunnels by undertaking a program of research on problems that arise in other branches of engineering. In the transmission of electric power for example, overhead cables continue to be plagued by a variety of wind-induced vibration problems which may lead to black-outs and costly line deterioration or failure. The trend towards very high voltages for long transmission lines has led to the need for bundled conductor arrays which minimize

Corona discharge but which have introduced new aerodynamically-based vibration phenomena. The NRC facilities are well-suited for investigating the problem, and studies have been done, under contract, for Canadian and American manufacturers and power utility companies. In particular, a fundamental investigation was carried out collaboratively with the Hydro-Quebec research establishment (IREQ) that has identified conceptual solutions to the problem. The ideas developed in the laboratory are being confirmed on a full scale test line facility established by IREQ on the Magdalen Islands that is the foremost of its kind in the world. The research and development program is focussed on the transmission line design for the James Bay power development project.

The use of high strength steels, welded construction and other advances in structural engineering have led to relatively flexible, lightly-damped structures that are more responsive to wind action. It has become common practice to carry out wind tunnel investigations of unusually tall or slender buildings, and intermediate and long span bridges of modern design. At NRC, techniques have been developed for simulating in the wind tunnel the properties of gustiness and wind shear that are characteristic of the natural wind, thus providing the correct environment for investigations of complex civil engineering structures. Currently an investigation for the British Columbia government of the proposed widened version of the Lions' Gate Bridge is

underway. This program includes a 1:100 scale full aero-elastic model for study in the 30 ft. x 30 ft. wind tunnel. A variety of modern Canadian and American bridges have also been studied. Design modifications that improve or stabilize the behaviour of the bridge result from the investigations.

The arrays of tall, slender pressure vessels that are used in Canadian heavy water plants are susceptible to problems of aerodynamic instability. Designers became aware of this effect when at one early plant, vibration amplitudes approached overturning limits and the tower foundations were damaged. Investigations at NRC have identified the phenomenon and led to appropriate techniques for suppressing the motion.

Studies of buildings are now routinely carried out on behalf of architects and engineers to assess wind-induced motion, wind loads, and surface pressures for facade and glass design. As well, it is frequently required to examine the possibility of adverse changes in the ground level wind environment that may arise as a result of the presence of a new major building. It is well established that the urban environment can be degraded in this way and there are examples in many Canadian cities. Methods have been developed for assessing and minimizing the effects of new structures.

Peripheral to the aerodynamic investigations has been the development of simple, lightweight dynamic vibration absorbers. Passive motion dampers of this sort are now

installed on an array of towers, on structural components of a large arch bridge on Cape Breton Island, and are proposed, as a result of investigations at NRC, for the solution of a costly vibration problem of a major new American bridge, and for a tall elevator tower at the La Prade heavy water plant now under construction.

The energy crisis and higher fuel prices have placed increasing pressure on highway truck transportation companies to economize on fuel in order to maintain their competitive positions. At highway speeds, aerodynamic forces on the vehicles account for a major part of fuel usage. A thorough investigation of basic design features and the effectiveness of commercially available aerodynamic add-on devices is now underway using 1:10 scale models of conventional tractor-trailer configurations. Also, in the field of vehicle design, considerable effort has been put into the aerodynamics of highway snow plows, snowmobiles and motorcycles on behalf of Canadian organizations.

In the design of ships it is important to ensure that there is an effective smoke stack that leaves the effluent well clear of the ship and prevents reingestion into ship ventilation systems and engine intakes, and eliminates the possibility of corrosive action by the gases on sensitive equipment. Wind tunnel studies to assess stack performance and to measure aerodynamic forces on the hull and superstructure

are carried out for Canadian designed naval ships, ice breakers, car ferries and other vessels.

In some of the areas that have been discussed, NRC and other Canadian institutions and universities have been in the forefront of technological advance and have provided international leadership. One example is the research at the University of Western Ontario into the response of tall buildings to wind turbulence. Another, the investigations by Ontario Hydro, Hydro-Quebec, and NRC into the aerodynamics of power cables. Research and development in all these areas and others should continue to provide industrial support of a specialized character and lead to more effective and more economical design.

These activities at NRC have been deliberately increased over the past ten years, not only in the volume of effort, but in the range of technology to which the work relates. Much of this work is in support of industry and is aimed at explicit problems, but it is found in many projects that basic or novel contributions to the technology are required. Publication of the results of the work appears in professional and scientific journals and proceedings. In addition to the experimental role, a specialized consultative capability has been created which is called on regularly to serve Canadian industry. The increased use of wind tunnel time for industrial aerodynamics complements the aeronautical usage and ensures optimal utilization of the wind tunnel facilities.

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IRISH MOSS

Supplies of agar-agar, a gelling agent used in the microbiological, pharmaceutical, and food industries were critical between 1940 and 1946 and an extensive survey was undertaken for alternate sources. The gelling agents in Irish Moss (Chondrus crispus) which grows on rocks in the sub-tidal zones of the Northern Atlantic Ocean were isolated by NRC scientists and their chemical nature determined. Though the gelling agents, the carrageenans, are not suitable as agar substitutes, they do have a number of unique properties that make them useful in the manufacture of a number of food and chemical products. About 80% of the world's supply of Irish Moss is harvested on the Atlantic Coast, principally in P.E.I. and Nova Scotia. In 1974 the landed value of this seaweed was \$5.8 million and it is the principal commercial seaweed in Canada. In Japan the annual value of the seaweed industry is about \$250 million. The harvesting of commercially important seaweeds is being promoted and regulated by the Fisheries Service (Environment Canada) but resources are limited and conservation is important.

When the Atlantic Regional Laboratory was opened in 1952, little scientific information was available on local marine plants, particularly algae. A long-term research program was initiated and has gradually developed over the years with the object of determining what algae are present

in the coastal waters of the Atlantic Provinces, their reproductive and biochemical processes, genetics, growth, nutrition, and chemistry, that is, of obtaining a background of knowledge on which development work can be based. Much of the early survey work on ecology was done by the Nova Scotia Research Foundation. The Atlantic Regional Laboratory conducts much of its research in collaboration with scientists in universities in the Atlantic region, and with guest workers and scientists from other organizations, including industry.

In 1967 the decision was made to establish a seaweed culture station on the shores of the Atlantic Ocean as a facility for growing marine algae in seawater under controlled conditions for experimental work and as a facility for examining the possibility of developing commercial methods of propagating Irish Moss. Success in the project is based on having a facility with flowing seawater available, on discovering the life cycle of Irish Moss, on determining the chemistry of the carrageenans, on discovering the relationship of the carrageenans to the life cycle of the alga, and the determination of the optimum conditions for growth and for synthesis of carrageenans. The technical success of the method for propagating Irish Moss vegetatively in tanks containing flowing seawater at the Seaweed Culture Station has interested two commercial companies who have established pilot plants and who are carrying out further development work. Commercial propagation of Irish Moss would permit an expansion of present markets and conservation of the natural resource.

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HIGH-POWER, LARGE-VOLUME, U.V. PRE-IONIZEDCO₂ LASERS

In 1970, when the first transversely-excited atmospheric pressure (TEA) CO₂ laser was reported by Beaulieu,¹ the Laser and Plasma Physics section had already been actively involved in applications of high energy pulsed lasers for a number of years. This activity had developed for two principal reasons: (A) one of the section's continuing experimental programs was concerned with the investigation of plasmas produced by intense laser radiation and (B) ultrashort laser pulses had permitted the development of several new plasma diagnostic techniques with extremely high spatial and temporal resolution. Although much of the NRC work on laser-produced plasmas had been carried out in gases and was of a fundamental nature, the original motivation for this work was the possibility of using lasers to produce high temperature plasmas of thermonuclear interest.

The development of the TEA CO₂ laser provided for the first time a practical gas laser capable of generating peak powers in the megawatt range. Furthermore, the active medium was inexpensive, readily available, and could be excited directly with electrical energy. As a result, such lasers were relatively simple to construct and much more efficient (approximately 10%) than solid state lasers.

¹A.J. Beaulieu, "Transversely excited atmospheric pressure CO₂ lasers", Appl. Phys. Letters 16, 504 (1970)

In common with many other laboratories around the world, NRC constructed their own TEA lasers and began to incorporate them into the experimental program previously carried out with solid state glass lasers. The original TEA laser described by Beaulieu was rapidly followed by a number of double discharge designs which permitted the construction of larger volume CO₂ lasers having maximum inter-electrode gaps of about 5 cm. Many laboratories attempted to scale the CO₂ laser to even larger apertures and the approaches adopted included the use of high energy electrons to pre-ionize the laser gas.

During 1971 a number of schemes aimed at stabilizing large cross-section, atmospheric pressure, glow discharges were investigated at NRC. By September 1971 a new transverse discharge device with a substantially better performance had been developed. In its original form this device had an interelectrode gap of about 5 cm and permitted the efficient excitation of large volumes of CO₂, N₂, and He gas mixtures at atmospheric pressure and with a high concentration (~ 30%) of CO₂. Stabilization of the discharge was achieved by an auxiliary multiple spark discharge formed between a trigger electrode and one of the main discharge electrodes. In operation, breakdown of the gas between the mesh and the trigger electrode occurred first and resulted in the formation of many small arcs. High speed photographic studies indicated that uv radiation emitted by these arcs produced volume photo-ionization

throughout the entire laser gas mixture. This provided a much greater stabilizing effect on the main discharge than photo-emission from one of the electrodes, a process which had been used in several other laboratories.

With a view to the development of a large volume CO₂ amplifier, capable of storing energies of about 100 joules, seven identical modules were assembled during the winter of 1971/72, with the discharge cross-section increased to 58 cm². When seven modules were operated together as a large oscillator, a total output energy of 300 J at an overall efficiency of ~8% was obtained. The peak power of the device exceeded 3 gigawatts and demonstrated for the first time that high power CO₂ laser systems could be constructed without resorting to the more costly electron-beam sustainer approach.

Additional scaling studies were carried out during the summer of 1972, in which the uv source and the main discharge were energized independently, thus permitting the development of the "flashboard," a much more effective, large area uv source. Although no full-scale laser module was constructed the results revealed that the electrode separation could be increased up to ~30 cm and confirmed that the construction of CO₂ lasers with apertures as large as 600 cm² did not present any major obstacle. This result rapidly led to the awarding of a development contract to Lumonics Research Ltd. who have now built and sold approximately ten 20 cm aperture CO₂ discharge modules. In addition the "flashboard" uv

radiation sources are now being used in other commercial lasers (Lumonics 600) and have found their way into many laboratories around the world. So far, the principal applications of these high power CO₂ lasers have been in research laboratories; however there is a good probability that industrial applications will evolve in the years ahead.

Additional experiments carried out at NRC have resulted in the successful operation of a small uv pre-ionized laser at a gas mixture pressure of 15 atmospheres. This development has extended the capabilities of the CO₂ laser even further since multi-atmosphere operation permits the generation of ultra-short pulses and allows the output frequency of the laser to be tuned continuously within a narrow band of wavelengths. This property makes the laser particularly useful for research in spectroscopy and photochemistry and it is expected that a commercial product based on this device will be developed.

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OPTICAL MULTILAYER COATINGS FOR ANTI-
COUNTERFEITING PURPOSES

In 1971 the Bank of Canada approached NRC with a request for suggestions of new ways to inhibit the counterfeiting of paper currency. Several proposals were made at that time, including, for example, the magnetic encoding of banknotes. The Optical Physics Section of the Division of Physics looked into the use of metameric colours, but found a more promising approach based on its ongoing research

program on the properties, design and construction of optical multilayer coatings. This work led to the development of a method that can offer protection to the citizen from small and medium sized counterfeiting operations.

Optical multilayer coatings usually consist of a substrate, which may be made of glass or plastic, onto which a number of thin films of different materials have been deposited. These materials may be elements, such as silver, gold or aluminium, or simple inorganic compounds, such as zinc sulphide, magnesium fluoride or zirconium dioxide. A commonly used method for the deposition of the layers is thermal evaporation in a vacuum. The thicknesses of the individual films are of the order of the wavelength of light, and they have to be controlled with a very high precision. Some multilayers may consist of as many as 50 or 60 different individual layers. The reflection or transmission of light by a multilayer coating depends on the number of constituent layers, their thicknesses and optical constants. The colour effects observed are due to the inference of light in thin films; the same principle that is responsible for the colours of soap bubbles and oil slicks. But because in the multilayer coatings many more films are involved, and because their thicknesses and optical constants can be controlled, it is possible to obtain almost any desired transmission or reflection characteristics.

With the NRC device, special optical multilayer coatings are made an integral part of the article to be protected from counterfeiting. Coatings have been developed at the NRC which change colour, or which reveal hidden designs when viewed obliquely. These effects cannot be duplicated by any known dye, ink, photographic or xerographic process. They should therefore enable anybody to distinguish at a glance an authentic article bearing such a coating from even the best counterfeit lacking it. The security of the device lies in the fact that the coatings can be produced only by the use of sophisticated and expensive equipment, and that their cost is prohibitive for most applications when made in small quantities. Patent protection for this idea has been obtained in Canada and several foreign countries.

Identicard Ltd., a Toronto-based Canadian company producing identification cards, learned about the NRC method from publicity in connection with a talk at a scientific conference. It carried out a market survey in 1973 on possible applications of the coatings and found that the coatings could also be used for the protection of identification cards, drivers' licences, passports, credit cards, cheques, share certificates and airline and lottery tickets. There exists a very considerable export potential for this product.

In view of these prospects Identicard Ltd. approached Canadian Patents and Development Ltd. and leased from them rights to this invention.

The mass production of such complex coatings, necessary both to supply the huge quantities needed and to bring down their cost, has never been attempted before. With the help of technical staff placed by Identocard Ltd. in its laboratories, the NRC had to do a considerable amount of development work to reach the present situation where the construction of a prototype production machine can be contemplated. It is expected that this prototype will be designed and built for the NRC by Sentrol Systems Limited, of Toronto, with the collaboration of the Canadian Vacuum Equipment Co. Ltd. of Montreal, and the Lembo Corporation of Canada, Midland. NRC will assist these companies to establish themselves in this new high technology industrial field. The construction of the prototype will be funded through the PILP grant program and should take about 14 months. After the conclusion of the tests on the prototypes, Identocard Ltd. will finance the construction of a full-scale production machine.

The techniques and equipment developed for this project will give Canadian industry a head start in the development of a range of new products, such as high-quality, low-cost optical coating and filters for scientific, technological, and commercial applications; improved and cheaper architectural coatings for energy conservation purposes; and coatings for solar-energy conversion.

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EXTRACTION OF BITUMEN FROM ATHABASCA TAR SANDS

National requirements for the production of synthetic crude oil from the Athabasca Tar Sands have been predicted to be about one million barrels a day within 10-20 years. At the present time the only technology available to exploit this immense national resource is the Hot Water Process currently used by Great Canadian Oil Sands (G.C.O.S.) in the only operational commercial plant. An important parameter in the operation of a Hot Water extraction plant is the amount of fines present in the feed material. The fines are defined as that mineral matter that will pass through a 325 mesh (44 microns) screen; this fraction may be further sub-divided into silt and clay components. The major problem encountered in the operation of Hot Water extraction plants is that the fines content of the deposit is often significantly higher than the expected value of 6-10%. This has caused major technical difficulties at the G.C.O.S. plant.

Hot Water extraction plants require huge quantities of water and there is a corresponding production of liquid effluent. The effluent is discharged at a temperature of 70°C and pH 9.3; it is also heavily contaminated with oil and cannot be discharged into natural waterways. The fines in the effluent remain as a stable aqueous suspension of clay and oil. This suspension cannot be completely recycled back to the process, because the suspended clay would further reduce the bitumen extraction efficiency in the primary stages.

There is, therefore, an overall accumulation of effluent. The current solution to this problem is to establish huge retaining ponds; these ponds will represent a continuing threat to the environment through seepage into natural groundwater and effects on local climatic conditions. These problems have been outlined in environmental studies carried out for the Alberta government.

The Colloid Section of the Division of Chemistry has had considerable experience in the field of fine particle technology and has also been involved in tar sands extraction projects. As a result of this experience, the Colloid Section was one of the groups approached by industrial and government representatives, to seek a solution to the problems currently being encountered by industry. Two approaches to the solution of the problems were adopted; first the treatment of the effluent to reduce the clay content, allowing greater recycle of the water and secondly the development of alternative bitumen extraction techniques, which would avoid or reduce the effect of high fines component in the feed. Of these approaches the second has received the most industrial interest.

Solvent extraction of the bitumen is one alternative to Hot Water treatment that has been extensively studied because its effectiveness is largely independent of fines content. Even in the Hot Water process, solvent extraction is used as a final recovery step. Another advantage of an anhydrous solvent extraction process is that the effluent is

a readily disposable solid. However, the problem with this technique has always been an unacceptably high retention of solvent in the sand tailings.

A process known as "Spherical Agglomeration" was developed in the Colloid Section a number of years ago, and is now beginning to achieve industrial acceptance. In this process a suspension of fine particles is agitated with a second liquid which preferentially displaces the suspending medium from the surfaces of the particles. Under suitable conditions the result is compaction of the fine particles into larger, spherical pellets, which are readily separated from the suspending liquid. By optimising the volume of second liquid needed to form the pellets it is possible to exclude most of the suspending medium from the internal pore volume. As applied to bitumen extraction from tar sands the process involves suspension of the sand in a suitable bitumen solvent, followed by further agitation in the presence of sufficient water to form the sand pellets. The bitumen remains dissolved in the suspending liquid and is separated from the sand pellets by a simple settling procedure. The pellets consist of sand and water with some residual solvent. The solvent is removed from the bitumen solution by distillation and recycled. Make-up solvent, to replace losses, is taken from the products of bitumen "cracking".

In order to combine the "Spherical Agglomeration" process with the solvent extraction of bitumen on a continuous

basis, it was necessary to develop a novel apparatus. This apparatus consists of a conical, rotating drum, so designed that counter-current solvent extraction of the bitumen and sand agglomeration occur simultaneously. The shape of the drum is such that the sand pellets are ejected at one end and the solvent-bitumen solution at the other.

The process has been licensed by a Canadian company, through Canadian Patents and Development Limited. At the moment the Colloid Section is collaborating with the licensee in the design of a larger laboratory unit, which will include all the prerequisites of a full-scale pilot plant. This unit will be operated to develop control parameters for the process and to determine its economic viability. If this program proves successful, funds from the private sector of industry will be available for the construction and operation of a commercial-size pilot plant. The development of the NRC process to commercial fruition will allow a more efficient extraction of bitumen from the Athabasca Tar Sands, while minimising the ecological damage threatened by the present industrial proposals.

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AN ENERGY-CONSERVING RAILWAY SWITCH PROTECTOR

Informal discussions with railway people are a long established custom of the National Research Council Laboratories, and the substance of some of these discussions has been codified by the NRC Associate Committee on Railway Problems. Major Canadian railways asked for the assistance of the Sub-Committee on Climatic Problems on the question of railway track switches failing as a result of snow and ice deposits.

The classical approach to the problem had been to provide heat; however, the combustion heaters that both major railways had installed during the 1960s were designed outside of Canada for much milder climates and had proven inadequate for many areas of Canada.

A multiple approach technique was employed on this problem. Initially environmental conditions were established for design and test standards that would be representative of natural conditions and capable of being simulated in an environmental chamber. Existing heaters were laboratory tested, eliminating those completely inadequate and, in cooperation with suppliers, upgrading and improving some marginal equipment.

While the above program was underway, a second phase was initiated to develop a suitable combustion heater for remote areas where insufficient electrical power existed to operate conventional combustion heaters. A pulse jet powered switch heater was developed, fuelled by propane and capable of operating from signal power.

A third phase was started when it was recognized that thermal protection would have to be considered an interim solution to the problem. The ideal solution is a new switch that is not subject to failure from ice and snow. A switch was designed that, in transferring with snow or ice present, subjects the foreign matter only to shear loading, in contrast to compression loading in existing switches. Design, development, and evaluation work on this concept are continuing and two switches have been made and field tested. It is considered as a long term (15 to 20 years) solution to the problem in view of the existing capital investment in point switches.

While conducting research and development programs to improve the performance of combustion heaters for switches and to provide alternate heaters for remote areas, consideration was given to other possible solutions to this problem. A new method of dealing with the snow problem of railway switches resulted from observations on another unrelated project.

One of the long range projects of the Low Temperature Laboratory is the study of snow removal from the tracks of high-speed, guided, ground transportation systems. One of the methods of snow removal under investigation is the use of high velocity air jets. During this test program, it was noted that once the snow was removed from the surface, the air jet could move the snow a considerable horizontal distance. A review of the literature relating to the terminal velocity of snow particles and the horizontal transport of snow as measured in

blowing and drifting conditions indicated that an air jet system forming a protective horizontal air curtain might be feasible, thus preventing falling snow from depositing in selected areas.

The terminal velocity of snow particles ranges from values less than 0.3 m/sec. to approximately 2.0 m/sec. depending upon the shape, size and density of the particle. The horizontal transportation of airborne snow is a power function of the wind speed and, typically, a horizontal mass flux of $1000 \text{ g/m}^2\text{-sec.}$ can be attained at velocities over 25 m/sec. The vertical mass flux is usually expressed in terms of the snowfall accumulation rate. Given the snowfall rate, the mean density of freshly fallen snow and the particle terminal velocity, an airborne vertical mass flux can be calculated. Snowfall rates vary widely, but in Canada the greatest snowfall in one day was 43 inches at Premier, B.C. on January 15, 1949. Thus, a design figure of two inches snowfall per hour should be acceptable.

From this data, calculations can be made of the theoretical air mass flow to protect a horizontal surface from snow deposition. There are other considerations that must be taken into account and in the specific case of protecting a track switch from snow deposit, these include the configuration of the switch, the clearance outline within which equipment can be mounted, critical switch areas, and allowable snow deposit areas. Another factor to consider is that a jet of air expanding freely in the atmosphere experiences a velocity

decay as a function of distance from the nozzle. This velocity decay precludes moving snow great distances horizontally by a single jet.

The question of configuration of a practical system to protect a switch was further complicated by the necessity to design for high wind velocities, up to 40 mph, having directions either in counter flow or crossflow to a protective air curtain. Initial experimental work and some of the practical limitations resolved the design to two outward directed jets moving the snow from within the area between the stock rails to outside of track. The clearance outline limited the height of the jet outlet to approximately rail head height. It, therefore, was necessary to give the jet a vertical component in order that the expanding air jet would clear the stock rail head and permit snow deposition in the selected areas. The outlet velocity of the jet was dictated by the considerations of mean velocity for snow transportation, velocity decay and counter flow velocity. The mass flow of the jet was dictated by the required horizontal mass flux of snow.

Following some small scale experimental work in the late winter of 1971-72, a prototype system was designed and fabricated during the spring and summer of 1972. It was tested initially in a large cold chamber under simulated conditions, and in the late fall of 1972 the prototype system was installed on an isolated inactive switch at an Ottawa test site. The horizontal air curtain switch protector consists of a centrifugal fan with

a low velocity inlet, a discharge duct crossing below rail level and between a pair of ties to connecting elbows. From each elbow, a longitudinal duct extends horizontally and parallel to the adjacent stock rail. A full length slit nozzle extends along the outside of each duct.

The horizontal air curtain requires a 5 KW electrical input to protect switches up to 22 feet long. Forced convection combustion heaters for switch protection require approximately one KW electrical input and a fuel supply equivalent to 250,000 BTU per hour. To compare the two systems on a more rational basis, the air curtain system would require approximately 60 to 70,000 BTU per hour in fossil fuel input to an electrical generating plant, allowing for plant and distribution losses. Thus for equivalent operating times, the horizontal air curtain could reduce the energy consumption by about 75 percent. Following a year of trials at the Ottawa site, the prototype was moved to Montreal and installed in the classification yard of the Canadian National Railways. After a second season of tests without a failure on either the inactive or the active switch, a decision was made to modify the design for possible production.

The second unit was produced to meet the revised design requirements. Numerous detailed changes were made to simplify component fabrication and assembly although the performance requirements were maintained. This second prototype was installed on a parallel switch in the CNR Montreal classification yard during the winter of 1974-75.

To date the original prototype has been exposed to a total of 267 inches snowfall over the past three winters without experiencing a failure. The average snowfall rate was 0.2 inches per hour. The highest average rate encountered during one storm was 1.35 inches per hour. The maximum snowfall accumulated during a climatological day was 10.5 inches.

Patents have been applied for on this switch protection system in a number of countries. Arrangements have been made to manufacture this equipment in Canada, under license from Canadian Patents and Development Limited. There are naturally a number of developments of these ideas already in view.

CNR has purchased a number of units from the licensed Canadian manufacturer to conduct a wide scale evaluation program extending from British Columbia to Nova Scotia.

It is anticipated that the existing design horizontal air curtain system powered by a three phase electrical supply will gradually be adopted for all switch protection in yards and terminals in view of the fuel saving to be realized. For main line switches where three phase power cannot be supplied readily, either single phase electrical or a diesel engine driven system may be required. These will require development by the laboratory and the manufacturer. Discussions are now being held on possible means of arranging for this development work in industry.

For the railways, ultimate economic benefits should be reduced costs of winter railway transportation in terms

of lower capital cost for equipment and lower operating cost with greater reliability. The manufacture of this system in Canada will eliminate the importation of some thermal protection equipment. The successful development and marketing of the air curtain switch protector should lead to an annual export volume in the \$10,000,000 range.

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BIOMEDICAL ENGINEERING

The Division of Electrical Engineering continues a 25-year involvement in cardiovascular investigations of diagnostic and therapeutic procedures. Projects are being conducted on ultrasonic diagnosis, cardiovascular research and development and instrumentation for patient treatment and diagnosis.

The Echo-Encephalograph

The development of a compact hand-held echo-encephalograph stemmed from an early ultrasonic study conducted in collaboration with Queen's University. A need was recognized for a portable instrument which could assess brain damage by detecting a shift of the midline ventricular structure of the skull. A potential application was visualized in assessment of damage incurred in accidents and the device was designed for possible use in ambulances in addition to clinical measurements.

The echo-encephalograph was developed over the period of 1970-1973. It was assessed at the renowned Basle Neurological Clinic where it was compared with the EMI brain scanner, a very complex x-ray system that employs a dedicated

computer for cerebral investigations. These tests showed the validity and high accuracy of the NRC instrument and it was exposed to clinical use in hospitals at Montreal, Kingston and Winnipeg. A patent was granted in 1973 and manufacturing rights were awarded to Radionics Ltd. Montreal. Picker International has acquired the U.S. marketing rights and approximately 80 units had been sold by November 1975. The echo-encephalograph has proven comparable in diagnostic capability with other more complex equipment, some of which is beyond the economic reach of many hospitals. The development was reported at three international medical conferences and evoked great interest.

Subsequently, a histogram plotter has been developed as an ancillary readout device. This has now reached the stage of commercial application and Radionics Ltd. has expressed interest in its manufacture. NRC continues to assist the manufacturer.

Cardiac Parameters in Pacer Studies

The Division of Electrical Engineering has been involved in cardiac stimulation since it provided the first cardiac pacemaker for a pioneer hypothermia study at the Banting Institute in 1949. The NRC contribution was recognized in 1975 on the occasion of the opening of Canada's first pacemaker plant by Medtronic Inc. In the period 1967 to 1974 the NRC group concentrated on biological energy sources to ensure longer dependable service by implanted pacers.

The study of cardiac parameters arose from these earlier investigations. It commenced in 1967 and was completed in 1974. The objective was to optimize stimulating parameters (pulse width and wave form) to conserve battery energy, extend pacer life and reduce cellular damage to cardiac tissue.

Overlapping the latter part of this investigation were studies of the thresholds of ventricular arrhythmia and disruption of contraction, and of the onset of ventricular fibrillation. They were initiated in order to resolve a controversy in the determination of appropriate levels of protection to be specified in Canadian hospital safety standards, in which the Division has a leading commitment.

In parallel with these investigative studies, the group collaborated with Atomic Energy of Canada Limited in the evaluation of nuclear pacers. In this study, AECL provided the energy sources and NRC designed and packaged the implantable pacers. The study is still in progress.

In cardiovascular research and development, the Division is established as a major centre. The studies of cardiac parameters have been applied in a program at Drexel University in the U.S.A., and the technology which it produced has been used in pacemaker design by Pacers Ltd. in Britain and Seimens Ltd. in West Germany. An extensive review of cardiac pacemaker technology was published in Critical Reviews of Bioengineering, in 1975 by a member of the Division.

The investigations of cardiac parameters have provided new data on the thresholds of cardiac disruption leading to

the irreversible state of ventricular fibrillation. The research has influenced the determination of levels of protection in national and international medical safety standards, revealing a much more critical situation in the application of modern catheterization techniques and revising old concepts of the nature of induction of ventricular fibrillation. An important result of the research may be a new clinical technique for mapping areas of cardiac infarction (tissue destruction).

An estimated 140,000 cardiac patients are maintained by implanted pacemakers based upon the NRC development.

Cardiac Tachometer

In 1972 a cardiologist suggested to the Division of Electrical Engineering that there was a need for an inexpensive, easily-applied heart rate meter for use during or following surgery, or for monitoring heart patients during exercise.

A pulse recurrence frequency direct-reading device was developed and licenced by 1974. It provided two modes of operation: from the blood pressure pulse in a finger or from an incorporated electrocardiograph amplifier and chest lead electrodes. The pulse detection technique was designed for anaesthetized patients where motion artifacts were not a problem. It utilized a simple and inexpensive transducer. Both devices performed well during clinical tests at the National Defence Medical Centre. The tachometer was completely engineered at NRC. The methods used for scale linearization

in the design of the cardiac tachometer are new and so much simpler that they are being used by other researchers. Five prototypes were built to eliminate anticipated problems in commercial production. The licensee, Harco Development Co., Winnipeg obtained a \$5000 grant from the Manitoba Development Corporation for design of a diecast plastic package, printed circuitry and assembly layout. The resulting instrument has been successful on both domestic and export markets. In the past one and one half years, the company has sold 140 units at an average price of \$300, generating a cash flow of approximately \$40,000.

The tachometer was designed from the outset with commercial manufacture in mind. In order to be competitive and inexpensive, reliable components were used, including the adaptation of a transistor radio earpiece as a pulse transducer. The circuitry was simplified in comparison with other heart-rate meters on the market. It permitted the measurement of both instantaneous and average heart rates. In addition the current drain from the batteries was so low that the unit could operate for extended periods of time without failure. This is a significant design feature for Intensive Care Units and long surgical procedures. Existing tachometers function for only three or four hours of continuous service. The NRC unit, with easily available transistor radio batteries, can operate continuously for five days.

* * * *

WIND POWER

The National Research Council has been designated, by the government's Energy R&D Task Force, as the lead research agency in the task of exploiting renewable energy resources. Wind energy is one of these resources, and it is presently being studied closely in many countries, including Canada. Unfortunately, its potential remains uncertain: estimates of its impact range from a small fraction of one percent of national electricity needs in the next 20 or 30 years, to as much as 10 percent or more.

The uncertainty is not one of resource supply, at least in countries with large geographical areas. In the U.S. it has been estimated that wind energy, if farmed over only the western plains states, could give four times the present national electricity consumption. Equally impressive statistics apply to Canada: for instance, there is much more wind power available within the drainage basin of the La Grande River in Quebec (James Bay Project) than the planned capacity of the massive hydro project now under construction there.

There are other attractions to the exploitation of wind energy. It is one of the most environmentally benign energy sources; the La Grande basin calculation just mentioned was based upon a wind turbine spacing so wide that even the wind environment itself would be essentially unaltered by the energy extraction. It can also be shown that the energy

invested in materials and manufacture of large wind plants can be returned within the first few months of operation - a net energy return period shorter than that of, say, nuclear plants.

However, many real problems must be faced before wind power systems can be brought into large scale use. At present the capital cost is too high to compete with most other forms of energy, especially in the highly populated parts of Canada where we have become used to cheap electricity. The productivity of a wind plant is highly sensitive to its location; in Canada high average winds are available on the east coast, in large areas around Hudson Bay and in the southern prairies. Most Canadians live elsewhere. At any given location, the wind is intermittent and often rather seasonal, so problems of energy storage have to be considered in some applications. There is also an environmental uncertainty. People are distressed by the unsightliness of large arrays of transmission towers; how would they feel if the towers had rotating blades? Power companies, at least in their operational branches if not in their research departments, remain to be convinced that wind energy can be mixed with their systems to provide reliable power on demand.

In spite of these deterrents to development, there are good reasons for sustaining a small, but vigorous wind energy program in Canada. One is to "keep our options open" in the face of an uncertain energy future, but of course this

can be applied to all R&D activities. There are other reasons. Five of Canada's ten provinces have coastal and island regions in and around the Gulf of St. Lawrence, one of the windiest parts of the country. Present energy costs are high in parts of these provinces, and likely to go on rising as the price of fossil fuels increases. Wind energy could be applied with local benefits today, and several provincial power authorities are examining its feasibility. Large and small wind turbines have many applications in more remote locations, where experimental plants are already operating. Most available windmills are small, expensive, and must be imported, although the required technology is well within the capability of Canadian industry. If even one-tenth of one percent of presently installed generating capacity in Canada were to be replaced by wind power, the wind plants would represent about \$50 million worth of business within Canada alone. One significant technological development has already resulted from Canadian research, first in government, and subsequently in industry. The vertical axis "egg-beater" turbine was an old "lost" invention, independently re-invented in the mid-1960's by Peter South and Raj Rangi at NRC, when consideration was being given to intermediate technology devices that might be appropriate to remote underdeveloped areas. Although initial small-scale wind tunnel investigations gave encouraging results, the project was maintained at a low level of activity. In the

early 1970's, just before the energy crisis struck the industrialized nations, the first large scale test was carried out in the new 30 ft. wind tunnel, and results were published. World-wide interest became intense and has remained so to the present time. A computerized aerodynamic performance theory suitable for design optimization has been developed, and aeroelastic model experiments and analysis have uncovered no obstacles to the construction of very large turbines of megawatt capacity.

The vertical-axis turbine has several advantages over other more conventional windmills. The most important of these is potential cost reduction due partly to its simple, light-weight structure. Power take-off is conveniently near ground level. There is no "tower" of the usual kind, and operation is independent of wind direction. Its aerodynamic characteristics make possible direct coupling, through commercially available synchronous or induction generators, to existing alternating current grids. In this service, the turbine automatically "unloads" in very high winds, so that no feed-back control system is required either for control in normal operation, or for the equivalent of blade feathering in large horizontal-axis propeller type windmills.

Small versions, rated at up to six kilowatts, have been developed with NRC assistance, to the production prototype stage by three Canadian manufacturers. One of these companies is now designing and building, under NRC sponsorship,

a large machine (150 ft. high) for direct coupling to the existing diesel-powered grid system in the Magdalen Islands in late 1976, where subsequent trials will be conducted by Hydro Quebec with the cooperation of NRC. The purpose of this project is to demonstrate the feasibility of this new type of power-generating wind turbine in a realistic application, under severe environmental conditions.

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DEVELOPMENT OF LEGUME SEEDS

The Prairie Regional Laboratory was opened in 1948 to develop research programs directed to the industrial utilization of agricultural surpluses (e.g. wheat) and wastes (e.g. cereal straws). The production of alternative crops was selected as an effective means of reducing surplus production. The selection of an alternate crop is based on three criteria: potential for economically competitive production, a domestic market, and potential for an export market. The first crop selected for R&D, rapeseed, fulfilled the three criteria. The program, which eventually involved other government departments, universities, and industries produced the "Cinderella" crop ranging from 3.5 to 5.0 million acres per year since 1971, several new industrial plants, a major export commodity and a gross productivity of 200-500 million dollars annually.

An evaluation of the program around 1961 indicated that rapeseed was replacing imported soybeans in fulfilling the requirement for a domestic vegetable oil. Since rapeseed had twice the oil content of soybean this effectively reduced the amount of protein in the form of domestically processed oilseed meal for the livestock industry thereby creating a domestic demand for another source of protein supplement. Consideration was given to three potential protein sources single cell proteins (SCP), leaf proteins such as alfalfa, and legume seed proteins. The legume seed proteins were given top priority and field peas were selected in 1967 for a new R&D program replacing the rapeseed research transferred to other organizations. Field peas had been successfully grown in Canada on a limited acreage, primarily for the soup trade, and there was a potential for an expanded export market based on world predictions of an increasing demand for protein by a growing population with an increasing standard of living. The field peas and legume seeds had higher protein contents (24%-30%) than the cereals (10-15%), and could be expected to replace soybeans (also a legume seed) both as a livestock feed and for human food products. The only research in Canada on peas was a limited plant breeding effort on varieties for canning and the soup trades, where protein content was not a factor.

The initial research provided basic information on production and utilization. A survey of the protein

variability in the world collection, conducted in collaboration with Agriculture Canada, and a limited selection program showed that the protein content of Canadian varieties could be increased by plant breeding and selection. This project was transferred in 1971 to the Crop Development Centre of the University of Saskatchewan which was created under a negotiated development grant by the National Research Council. Nutritional evaluations in collaboration with the Animal Science Department of the University of Saskatchewan established the quality of the protein. Since protein was the key factor, dry milling and air classification were established as the preferred processes both technically and economically. The purchase of laboratory-scale industrial equipment established a facility to produce quantities of protein and starch for utilization studies. Samples of protein and starch were provided to interested feed and food industries for evaluation in market products. The positive responses led to feasibility studies for a primary processing plant by Canadian industries. A pilot plant constructed in 1972 by Newfield Seeds operated on contract acreage and produced protein and starch in sufficient quantities for plant scale tests by feed and food industries. The positive results led to the construction of a full scale (50 tons/day) commercial plant. The same company licensed patents developed at the laboratory for snack foods and meat extenders and are

conducting the necessary development research under the Industrial Research Assistance Program of the National Research Council.

The present program on production and utilization of legume seeds is being expanded with emphasis on two key areas. The starch yield from legume seeds is twice the protein yield, and consequently, expanded utilization depends on the development of markets for this by-product. No research was being conducted in this area by any other Canadian research group.

A research program on "nitrogen fixation", the ability of legumes and soil microorganisms to convert atmospheric nitrogen into ammonia for protein synthesis, was initiated in 1967. This program is directed particularly to field peas and the major advances that have been made are being tested in practical plant selection programs. The effects on commercial chemical fertilizers of rising costs and availability of energy have recently made research on nitrogen fixation a high priority in countries concerned with agricultural production. Canadian interest is concerned with improving the economics of legume production by reducing the fertilizer requirements and optimizing crop and protein yields.

The present production of field peas (excluding the soup and canning trades) of 12,000 acres is valued at around 1.5 million dollars a year, with a similar value for fababeans.

The field pea acreage will double in the next crop year with construction of the commercial plant. The target figure for Canadian production of legume seeds is one million acres which would place the industry in the 100-150 million dollar a year category and provide the farmer with another crop, create additional industries, and give Canada a protein source presently only available through imported soybeans.

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DEVELOPMENT PROJECTS OF THE CANADA INSTITUTE
FOR SCIENTIFIC AND TECHNICAL INFORMATION

Canadian Selective Dissemination of Information (CAN/SDI)
Service

The initial work on the computer-based current awareness service commenced in 1966. It scanned the citations of scientific and engineering papers published in selected journals, and provided NRC scientists and engineers with bibliographies of papers in their specific fields at regular intervals. The initial experiment was based on the Chemical Titles data base, one of the first indices to be made available commercially in machine readable form. After a development period (1967/69) of serving NRC personnel, the service was made available nationally on a subscription basis in 1969, with two data bases. Subsequently, the service grew rapidly until now there are 15 data bases and 2,091 subscriptions serving over 6,000 engineers and scientists across Canada. The service is supported by some 500 NRC-trained search editors in government, industry, and the universities. This service is probably the best known of its type in the world, having been made available internationally through UNISIST. NRC has provided the software and expert assistance in the establishment of the system in Australia, the United Kingdom, South Africa, Argentina, India, and Mexico.

Information Exchange Centre for Federally-Supported University
Research

In July 1970, NRC was directed by the Cabinet to establish

an information exchange centre to cover all federally-supported university research in all of the sciences. A 19-member task force representing the main granting and user agencies was convened to identify objectives and outline methodology. In early 1971, a small working unit was formed. It designed a data input form and began negotiating with 22 federal agencies regarding who is doing what research where and how it is supported. In May 1972, the first annual data base for IEC was completed containing 10,363 ongoing research projects in the 1971/72 fiscal year. A year later, the first 2-volume IEC Directory was printed and offered for sale at \$50.00. All 350 copies were sold in less than four months. This Directory has become a regular annual publication of the Canada Institute for Scientific and Technical Information, and a standard reference tool for Canadian libraries, government agencies, and research institutions. The latest edition covering fiscal year 1974/75, contains 9,425 current research projects as reported by 29 federal granting agencies.

Canadian On-Line Enquiry (CAN/OLE) Service

This is a computer-based, interactive system for the retrospective searching of large bibliographic files. It is based on a general-purpose data base management system being developed by NRC for such purposes. The work commenced in 1972, and in 1973 the system was used on an experimental basis by the Reference Section of CISTI. In July 1974 the CAN/OLE Service was commenced on an experimental cooperative

basis by 15 centres in federal and provincial agencies, universities, and industry. Each centre contributed a monthly subscription fee plus additional charges for use over a threshold level. On April 1, 1975 the service was placed on a fee-for-service basis and additional applications were accepted from organizations that desired to use the service. A target of 40 centres was set for fiscal year 1975/76. Four of the world's largest data bases are available for searching, covering the following subdivisions of the world's scientific and technical literature: chemistry; physics, electro-technology, computing and automatic control; the life sciences; and engineering. In addition, the Union List of Scientific Serials in Canadian Libraries can be searched for the location of libraries holding the publications, once the references of interest have been identified. Though still under development, the system has been compared favourably with the two largest American services by studies done at the University of Calgary, but the number of data bases is not as extensive as those available on the American systems.

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APPENDIX "26"

REVIEW
OF CERTAIN RESEARCH PROJECTS
THAT WERE DESCRIBED IN CASE HISTORIES IN 1968

BY THE
NATIONAL RESEARCH COUNCIL OF CANADA

26 MAY 1976

THE PROTEOLYTIC ENZYMES OF A MYXOBACTERIUM

Dr. D.R. Whitaker, who conducted the research described under this heading in 1968, left the National Research Council in 1970 to become a professor at the University of Ottawa. He continues to do research in this subject and collaborates with the X-Ray Crystallography Section of the Division of Biological Sciences.

The research led to one patent during the period from 1968 to 1975. At one time, Canada Packers Limited was interested in the use of the technique for the production of enzymes to be used in detergents. This interest died because of economic reasons and problems of allergic reactions to enzymes in detergents. The technique is still of interest, however, in the removal of hair from hides being prepared for tanning. The process is expensive compared with traditional methods using reagents such as sodium hydroxide, but could become important if more stringent regulation of the quality of effluents from tanneries is imposed. Canada Packers is also interested in the use of the technique to solve economically the problem of providing adequate dietary protein to calves that are separated from their mothers. The use of proteases of myxobacterium with vegetable protein has produced some promising results.

NEW ADVANCES IN ULTRAHIGH VACUUM TECHNIQUES

Work at NRC in the Electron Physics Section of the Division of Electrical Engineering in the two related areas of ultrahigh vacuum techniques and surface science continues to evolve within the framework of rapid changes in these areas on a world-wide scale.

Research has continued in the related areas of ultrahigh vacuum (extremely low pressures) and the study of well characterised surfaces. These areas are closely coupled because ultrahigh vacuum is perhaps the major recent technological advance permitting a detailed study of controlled surfaces at the atomic level, and conversely the pressure conditions in an ultrahigh vacuum system are almost entirely the result of gas-surface interactions.

Since 1968 a book has been published by NRC personnel entitled "The Physical Basis of Ultrahigh Vacuum" (Chapman and Hall, London, 1968). This book has received good reviews on a world-wide scale and has been translated into Japanese. The period of 1968-1975 has seen the publication by the Electron Physics Section of over 60 articles in scientific journals as well as presentation of a commensurate number of presented papers. 6 Patents have been issued. 2 were for a radically new method of pumping called accommodation pumping, which unfortunately does not promise to become a commercially viable method for transporting significant quantities of gas. 3 Magnetron gauges, first developed in the Electron Physics Section, now rest on the moon's surface and provide man's only direct measure of lunar atmospheric conditions.

During the period 1968-75 an explicit attempt was made to interest Canadian industry in manufacturing some of the devices developed in the laboratory as a result of research in the areas of ultrahigh vacuum and surface science. A new Canadian company Nanovac Ltd., was formed and selected 6 laboratory devices for further investigation.

Some company development took place but after an extensive market survey the Company decided not to proceed to production. This was probably a wise decision since the market for these devices had probably peaked. However the laboratory attempt to transfer devices to industry continues. Currently 3 new developments, one of large scale are being promoted. Several Canadian companies have shown interest and are being kept fully informed.

A new venture for the laboratory has been a close association with SEMCO Instruments Ltd., an Ottawa firm manufacturing scanning electron microscopes, whose research group has been housed in rooms adjoining those of the Electron Physics Sections. This pilot experiment has illustrated many of the detailed problems of transferring laboratory technology to industrial production.

OXIDANTS AND ANTIOXIDANTS

The extension of the useful life of petroleum-based lubricants has been a continuing interest of the Division of Chemistry for many years. The case history written in 1968 described the development of a theory of antioxidant action that is now used throughout the world in the discovery and manufacture of industrial antioxidants. Since completing this study, classical oxygen-uptake techniques have been extended to experiments with substrates in the absence of inhibitors to unravel further the kinetics of certain autoxidations. More recently, these kinetic studies have been improved by the application of the technique of electron spin resonance. This technique allows much more rapid progress and provides new information, such as the activation energy for a reaction to proceed.

There are both theoretical and practical interests in this work. For example, knowing the chemistry and kinetics of an autoxidation reaction, variations due to different conditions, such as a higher temperature, can be more reliably predicted and suitable antioxidants evaluated.

This subject is much broader than petroleum chemistry and the National Research Council Laboratories have recently provided, for example, the leading plenary lecturer for an international symposium held in Sweden on the development of rancidity in fats and oils, and the only non-medical contributor to a symposium on Batten's disease¹organised by the American Foundation for Children's Brain Diseases.

¹Batten's disease (Neuronal-Lypo-Fuscinosis) is a degenerative brain disease in children. It is always fatal. It involves the degeneration by oxidation of the fatty tissues that compose the sheath of the nerve.

SPHERICAL AGGLOMERATION OF MATERIALS

In 1968 the case history described a discovery *so new that its potential has not yet been exploited*. Patent applications had been filed on such potential uses of the technique as the separation of bitumen from tar sands, the preparation of dispersible pigments, the upgrading of coal for coaking, and the production of spherical shot. The reply presented to the Senate Special Committee on Science Policy by the National Research Council in February 1976 presented on page 313 a new case history on the extraction of bitumen from Athabasca tar sands, the most advanced development of the discovery first described to the Committee in 1968.

The process has been licensed by a Canadian company through Canadian Patents and Developments Limited. The National Research Council is collaborating with the licensee in a project to obtain data related to production. If the results are favourable, a full-scale pilot plant will be built and financed by private industry at a cost of about \$5 million. A second company, in the United States, is also engaged in the development of the process.

ETHYLENE OXIDE PRODUCTION PROCESS

The development of alternative schemes for the preparation of ethylene oxide was initiated by Dr. A. Cambron about 1937 partially owing to national defence interests. In the nearly 40 year interval the commercial market for ethylene oxide, particularly in plastics and anti-freeze uses, has increased enormously - a large plant in the U.S. in 1950 was 65×10^6 lbs/annually - a single company may now produce over 500×10^6 lbs/annum. Silver is a unique heterogeneous catalyst for the direct oxidation of ethylene to the epoxide. Complete combustion to CO_2 and water occurs simultaneously. New processes therefore depend on the ability to get higher selectivities without sacrifice of productivity, or undue increase in production or capital costs.

Cambron's catalyst was a silver alloy that was flame sprayed or atomized directly on to heat exchange surfaces. The alloying element was subsequently leached leaving a silver sponge. This was a unique feature of the operation. It was less sensitive to extraneous damage, was physically stronger and was longer lived than its competitors. Its shortcomings were a high silver inventory and difficult replacement.

Cambron's process was licensed by C.P. & D.L. to Stone & Webster Engineering Corp. of Boston and New York, who would design and build the required plants. Pilot operations were carried out by Firestone Rubber in Akron, and Allied Chemicals in Virginia, in addition to several years of laboratory pilot operation in the Applied Chemistry Division. Several other Stone & Webster customers examined the pilot results closely. The process was never adopted commercially since it lost out by a narrow margin in competition to a similar direct oxidation process developed by Scientific Design in the U.S. Laboratory work in Ottawa

was finally abandoned although it still remains a first rate opportunity should anyone get a bright idea on means of improving the economics.

Spin-off from the project includes:

- Cvetanovic's extensive contributions to the chemistry of olefin oxidation which, while they did not usefully improve the economics of the process were sufficiently related to atmospheric chemistry to make him an instant expert on smog and lachrymator formation in cities, the probable effect of S.S.T. on the ozone layer and the like,
- Keith Ingold's excursion into the direction of oxidation of olefins in boiling dimethyl phthalate. This reaction produced uniquely epioxides from ethylene, propylene and butene and excited considerable interest in Shawinigan Chemicals and in the Canadian Chemical Co. Both companies established potential processes as a result of Ingold's work. It was shown in both places that the dimethyl phthalate was providing methoxy radicals that were responsible for the reaction. With neither company did the process become commercial although both maintained patent positions.

PRECISION POTENTIOMETERS

The value of the potentiometers manufactured by Guildline Instruments Limited to a design of the Division of Physics of the National Research Council has been almost \$2 million. The manufacture of these instruments is being phased out now as a result of new technology, notably the current comparator of the Division of Electrical Engineering and new high precision digital voltmeters. The selector switches and high-stability current controllers designed for use with the precision potentiometer continue to be popular items because they are still the best available.

Collaboration between the Division of Physics and industry has continued with the development of a line of shipborne and laboratory instruments for the measurement of temperature and salinity. These instruments, which were developed at the request of Canadian oceanographers, are also manufactured by Guildline Instruments Limited. Worldwide sales of these instruments and other peripherals had amounted to \$1 million by 1975 and the sales projection for 1976 is \$0.8 million. This represents about one-third of Guildline's production.

The laboratory salinometer designed by the National Research Council has become the recognized international standard instrument.

DEVELOPMENT OF RAPESEED AS A CROP IN CANADA

The rapeseed program at the Prairie Regional Laboratory comprised 14 projects in 1963, involving

- analytical methods for use by plant breeders in industry,
- optimum conditions for extraction and processing of rapeseed oil and oilcake,
- nutritional evaluation of rapeseed oil and oilcake, and,
- basic research on proteins and glucosinolates to improve varieties of rapeseed.

The number of projects dropped to nine by 1968 and to three by 1975, and even these projects were reduced to about half the effort that formerly had been applied to them.

Sufficient progress has been made in the program to satisfy the needs of plant breeders in industry, except for nutritional studies on rapeseed oil. Research in this field has been increased by other government laboratories and by university departments. The practical development of new varieties of rapeseed with negligible levels of undesirable factors, such as erucic acid and glucosinolates, was underway in 1968. The contribution of the Prairie Regional Laboratory to the development of the rapeseed industry was consequently considered to be complete and most of the staff that had been involved in this program turned their attention to new research projects, either in legume seeds or in the monitoring of insects. The development of legume seeds is described in a new case history presented on page 332 of the Council's reply to the Senate Special Committee on Science Policy dated February 1976.

The processing of the rapeseed crop in 1968 involved four crushing plants. Two of these plants doubled their capacity by 1974 and in that year four new plants were projected for construction. Only one of the latter plants is coming on-stream in 1976. A second plant is under construction, but the other two have been dropped for economic reasons. These reasons include a large increase in the supply of palm oil, rising production of soybeans in Brazil, and the freight-rate structure in Canada. The forecast acreage of rapeseed in 1976 is 2.2 million acres, 30% less than last year. The domestic crushing industry anticipates a dramatic reduction in demand. While these developments are a setback to the rapeseed industry, they emphasize the importance of the program to develop a legume-seed industry as an alternative both for agricultural production and industrial participation.

The research staff of the Prairie Regional Laboratory have continued to serve as experts on rapeseed for trade missions, special assignments, and consultation. Some recent examples are

- participation in a two-week training school on oil seed processing in Malaysia, at the request of the International Development Research Centre
- participation in a two-week trade mission looking at the rapeseed market in the United States,
- participation as a technical member of Rapeseed Utilization Assistance Program of the Department of Industry, Trade, and Commerce.

Improvement of Machine Tool Techniques and Productivity

Shortly after the date of presentation of previous remarks to the Senate Committee, HMCS Kootenay had a severe engine room explosion which necessitated regrinding of the main gearing for one turbine. The National Research Council installation, previously described, was (and is) the only one in Canada capable of doing the work. The repair was accomplished at a higher standard than the original manufacturer, and the ship is still in service. Subsequently, less severe work was performed on the gearing of HMCS Fraser and HMCS Skeenay. In one case the gearing being, flown by military transport from Europe, precision ground and returned to ship in one week.

The process of numerical control of machine tools previously alluded to, has been enlarged to include drilling and tapping and boring and milling. In these cases, the improvement in productivity, in comparison with normal tools of the same sizes but without numerical control, is in a widely varying ratio but generally speaking in the neighbourhood of 10 to 1.

The next step, somewhat less conventional than the above, has been to introduce the new processes of electro-discharge machining, electrochemical machining. These processes offer productivity improvement in the order of 20 to 1, and are especially valuable in the machining of hard materials or odd shapes.

The newest evolution in this train of development has been the introduction of electron beam welding, which is proving valuable in the repairing of aircraft and paper machines and for construction of various machinery, especially in the nuclear reactor industry. The excellence of this process permits revolutionary advantages in design.

Our collaborations with Canadian companies range over much of Canada, one client being in Halifax and two in Vancouver, our clients numbering about seventy. Interest in western Canada has been so great that we have installed a small numerically controlled machine in our Vancouver Laboratory.

Vascular Suturing Instruments

The Vascular Suturing Instrument, previously developed, has been put into commercial production with disposal plastic staple and anvil bushings. Although sales have been very disappointing, the small number of instruments in clinical use have been used in a large number (well over 1000) of kidney and other surgical procedures. A larger version of the instrument has been made and used very successfully for 90 liver transplants in pigs. The work is in collaboration with the Sick Children's Hospital, Toronto, and appears promising for clinical use when the time comes. Still a further "end-to-side" instrument has been made for surgical evaluation.

Perhaps, the most useful outcome of the Vascular Suturing Instrument development has been the evaluation of intimate contacts with a number of hospitals and surgeons. Examples of these collaborations are the following -

Evaluation of changes to Harrington equipment for treatment of scoliosis. Construction of two experimental forms of tool to facilitate the Harrington procedure for spinal surgery.

In collaboration with the Vancouver General Hospital, a modified form of external tension-relieving "splint" for counteraction of eviscerating forces and prevention of dehiscence of incisions closed with very low tensile strength suture material.

In collaboration with the Ontario Children's Rehabilitation Centre an unpowered manually controlled, hydraulic device for a lower limb prothesis has recently been designed, constructed and tested on a patient. The hydraulic unit provides control or knee bending action, unimpeded straightening and automatic locking of the knee.

A device for the measurement of foot angle about the patient's leg axis (to obtain the degree of "club foot" condition) has been developed and constructed in co-operation with a medical doctor and is being evaluated on patients up to five years old.

A page turner has been developed for handicapped readers and is on the point of commercial exploitation. A number of hospitals and other institutions have shown interest in this development.

For the treatment of severe burns, there has been developed in Britain a type of air bed with a porous fabric which permits a film flow to support the body with much reduced damage to raw flesh. This scheme has been taken up by import and parallel development and is now being assessed by two Canadian hospitals and surgeons.

Brain Cooling For Surgery

As postulated in the previous report, the "spin-off" arising from this project proved to be more valuable than the original project. The surgical procedure for certain stroke cases arising out of the availability of the cannulae developed for use with the heat exchanger for brain cooling is now carried out on a routine basis by surgeons at the medical centres. No attempt has been made to keep an account of the number of patients treated for strokes using this technique and equipment since it has become routine.

The engineering research and development background has since been applied to organ preservation, thereby aiding experimental surgical programmes on organ transplant.

The technique of inhibiting blood circulation by cooling has been extended, in collaboration with the Montreal Neurological Institute, to the control of circulation in the spinal column. In circumstances of certain forms of injury to the lower part of the back, the ensuing over supply of blood leads to clotting, irritation of the spinal cord and subsequent paralysis. In order to introduce refrigeration equipment into the spine, it has been necessary to develop various tools and other apparatus. A variety of animal experiments have been conducted and prospects for clinical use appear good.

DEVELOPMENT OF ANALYTICAL METHODS AND INSTRUMENTS IN PHOTOGRAMMETRY

This work has had great impact on the further development of photogrammetry both internationally and domestically. The most significant points are the following:

- Instronics Limited of Stittsville, Ontario, has entered into an agreement with the National Research Council to manufacture an updated version of the analytical plotter, ANAPLOT. A prototype of the ANAPLOT has been built by Instronics and a number of sales are being negotiated. Depending upon the configuration, the price of the instrument will vary from \$150,000 to \$300,000.
- Based on the analytical plotter and the automatic image correlator (another leading Canadian invention), a new and extremely powerful mapping system, the Gestalt Photo Mapper, has been developed by a Canadian company in Vancouver and several units have been sold in Algeria, Canada, Ireland, and the United States at prices between \$600,000 and \$1,000,000. Further sales are being negotiated.
- Foreign industries recognized the importance of the Analytical Plotter invented by the National Research Council and they launched their own manufacturing programs based on this concept. In addition to OMI - Italy (which acquired the initial licence around 1960 in the absence of interest from Canadian industry), both MATRA - France and BENDIX - U.S.A. recently announced their own products.

The Canadian map-making industry, the second largest in the world, is making extensive use of analytical methods and computer programs developed by the National Research Council in support of their domestic and foreign business.

- An important experimental mapping project in Columbia is being planned. It will make use of the ANAPLOT and the Gestalt Photo Mapper. The project, supported in part by the Canadian International Development Agency will cost between \$3 and 4 million.
- The Canadian space effort (ERTS project) and related technology have profited considerably from the work of the National Research Council in the field of analytical photogrammetry. An analytical photogrammetric method suggested by the National Research Council is also considered at present to be a possible solution to very critical docking operations in connection with the space platform mission.

The efforts of the National Research Council in analytical photogrammetry have helped Canadian industry to become a leader in this extremely sophisticated technological field, opened up significant foreign markets, and helped to create work for many highly skilled technicians and experts.

CRASH POSITION INDICATOR

Research on a crash position indicator for subsonic, fixed-wing aircraft began at the National Research Council in 1954 and continued for 7 years. In 1961 the system for subsonic aircraft was transferred to Leigh Instruments, which at that time employed 7 people. The crash position indicator was the first major project of Leigh Instruments, which has since grown into a wholly-Canadian-owned corporation of 9 companies, with a gross income of \$30 million a year and interests in the United States, the United Kingdom, and Germany.

The National Research Council worked on a crash position indicator for supersonic aircraft from 1961 to 1968. From 1968 to 1971 it began, but did not complete, work on a system for helicopters. An interim system for helicopters was flown in a NRC helicopter from 1965 to 1970 and it is still evolving slowly.

The professional staff that had devoted all its work to the research and development of crash position indicators redirected the major part of its effort in 1961, at the request of the Department of Industry, Trade and Commerce, to the development of a crash sensor for the deployment of automobile crash protectors, such as air bags. The expertise gained in its work on aircraft crashes was directly relevant to the protection of the occupants of automobiles with air bags. A patent for the first stage of an automobile crash sensor was granted in the United States last month.

Although the work of the group is no longer concerned primarily with crash position indicators, it continues, as the leading Canadian laboratory in this field, to advise both Leigh Instruments

and the Department of National Defence.

Since 1968 the sales of crash position indicators and derivatives by Leigh Instruments have been \$60 million.

Wave Absorption Breakwater

Since 1962, when the first perforated breakwater was constructed at Baie Comeau, Quebec, the concept has gained international recognition. Perforated breakwaters have now been constructed at Chandler Harbour, Quebec, Saulnierville, Nova Scotia and at Roscoff Harbour in France. Numerous perforated breakwaters have also been built in Japan.

The Ekofisk oil storage tank which has been in use in the North Sea since 1973, has a perforated chamber around its perimeter to reduce the wave forces on the structure and to reduce scour of the foundation material. The storage tank is approximately 300 ft. in diameter, 295 ft. high and sits in 230 ft. of water. Similar structures being built at the present time are the Frigg and Ninian drilling platforms. The Ninian platform is the largest to the present time. It measures 460 ft. in diameter, is 560 ft. high and has perforations in the area of the most severe wave attack at the water surface and also at the base for prevention of scour. This platform is to be used in the North Sea in a water depth of 460 ft. These structures represent financial commitments of the order of \$10⁸ and their design and construction have important impacts on regional economics.

Mainly due to a lack of adequate manpower and facilities in the sixties, developments beyond the original concept could not be carried out at the National Research Council. All subsequent model tests and analyses for perforated drilling platforms have been performed in the U.S.A. and France.

However, recently a new wave flume has been constructed at the National Research Council and experiments have been conducted in the Hydraulics Laboratory to determine the feasibility of using a perforated breakwater for the proposed harbour at Gabarus Bay, Nova Scotia. These model tests were necessary to examine the limited design methods available and also to estimate the suitability of a perforated caisson design in the ocean conditions existing at Gabarus Bay.

For the testing in this field as necessary, the Department of Public Works of Canada has shown some interest to support part of this work financially. A new type of wave machine has been designed, but is presently awaiting financing before it can be manufactured.

The most general outcome of the above work has been the involvement in important harbour studies, namely - Churchill, Manitoba, Miramichi Channel, N.B., Port-aux-Basques, Nfld., Gabarus Bay, Nova Scotia. The National Research Council wave refraction and diffraction computer programmes are now the most advanced in the world.

The major use of perforated breakwaters has been in the construction of oil storage tanks. Royalties earned up to 1975 for breakwaters and tanks amounted to \$160,000 and another \$160,000 has just been received for the construction of an oil storage tank in the North Sea. There are plans for the construction of one tank a year in the North Sea for at least the next five years; a royalty income of at least \$160,000 a year is anticipated. It may be of interest to note that the first tank in the North Sea paid for itself in 20 days because operations were not interrupted by the bad weather that followed its installation.

A new design of oil tank using this licence is in the final planning stage. The tank, to be used off the coast of Alaska, will stand in 1,000 feet of water.

CONTROL OF COPPER SMELTING

The exposure to the problems of the mineral processing industry experienced by the staff of the Division of Mechanical Engineering during their work on the control of copper smelting has led to some new work on the handling of materials and the scheduling of operations in this industry.

Starting in 1970, an interactive computer model of the converter aisle of a copper smelting plant operated by Noranda Mines Limited was developed. The model was completed in 1973. It has been used to train foremen and to develop operational strategies. Improved operating policies have increased production capacity by 2%, which is worth about \$2 million a year in extra production. The model has also been used to evaluate proposed locations for new components in the plant.

The successful development and use of this model has led to the application of the concept to three other plants:

- the operation of a basic oxygen furnace shop by Stelco in Hamilton; this model was developed between 1972 and 1975;
- iron smelting by the Quebec Iron and Titanium Company, Sorel Quebec; this model was developed between 1974 and 1976;
- copper and nickel smelting by INCO, Sudbury; the development of this model began in 1975 and is still continuing.

MICROWAVE DRYING

The early history of the microwave heating project was described in 1968. Since then, a group comprising 2 engineers and 2 technicians within the Electromagnetic Engineering Section of the Division of Electrical Engineering, has continued to develop technology which may be of benefit to Canadian industry. New projects usually result from cooperative programs with industry or other government departments, or they are generated internally.

Cooperation with Industry

A close working relationship is still being maintained with Mega System Design Ltd. of Toronto, a firm founded by people formerly with Devtek. Various improvements have been made to the original Glue Line Dryer used in the production of multiple copy business forms, and the unit is still being manufactured. Other devices which were developed cooperatively with Mega include an efficient drying chamber for photographic film, an Ink Line Dryer, a compact magnetron power supply, and a Microwave Moisture Gauge for continuous sheet materials such as photographic film, cellophane or paper. Over the years the company has developed considerable competence in microwave technology and is becoming progressively less dependent on the assistance of the National Research Council.

Some work on moisture gauges has also been conducted in cooperation with Electronic Associates, another Toronto firm that specializes in the instrumentation of paper mills. The end result was the "Gigatel" moisture gauge, which is still being manufactured. The feasibility of a new electronically-scanned, moisture-profile instrument is being studied in cooperation with Sentrol Limited, the same company under new name.

Another cooperative effort involves yet another Toronto firm, G.S.W., that is interested in improving the uniformity of cooking in domestic microwave ovens. A novel "mode stirrer" scheme is under investigation.

In addition to the above, numerous inquiries are received from industry directly or via the Technical Information Services of the National Research Council. This frequently necessitates some experimental work to evaluate the practicability of suggested applications.

Cooperation with Other Government Departments and NRC Divisions

Several years ago, the Food Research Institute of Agriculture Canada initiated experiments to continuously process wieners using microwave energy. An applicator for operation at 915 MHz was constructed and low power tests gave promising results.

A program is underway in cooperation with NRC's Prairie Regional Laboratory to develop a microwave method for the partial sterilization of pea flour and pea protein concentrate. Following laboratory tests, a prototype unit has been constructed and shipped to Saskatoon for tests and evaluation. The apparatus is also suitable for evaluating other food-oriented applications, such as the non-chemical sterilization of spices.

Internally Generated Projects

The main thrust has been to develop techniques and apparatus in anticipation of future needs. For example, a method has been developed which makes it possible to dry a continuous sheet of material, such as photographic film or paper, to virtually constant dryness without an expensive moisture gauge.

An efficient drying chamber for filamentary materials such as fibreglass has been constructed, and an automated tuner capable of handling 30 kW of microwave power has been developed.

A simple device utilizing liquid crystals has been devised to warn of excessive leakage of microwave energy around the doors of domestic microwave ovens or industrial equipment. A patent has been applied for.

Laboratory facilities have been expanded to include a 30 kW source of microwave power, a transport system for continuous sheet materials, means for applying coatings or patterns to a web, various drying chambers, and moisture gauges to monitor input and output moisture levels. In addition, a 27 cubic foot "microwave oven" for batch processing has been built. This equipment is unique in Canada and is available to industry for tests or feasibility studies.

The following is a list of devices and developments that have had some commercial success:

(1) Mega System Design Ltd -

- Glue Line Dryer : 32 units sold at \$13,000 each.
- Automatic Tuner : incorporated in about 15 glue line dryers.
- Drying Chambers for Sheet Materials : 3 sold at \$20,000 to \$25,000 each.
- Ink Line Dryer : 1 sold for \$7,500.
- Microwave Moisture Gauge : 6 sold at \$8,000 each.

(2) Electronic Associates (Sentrol Ltd.) -

Gigatel Moisture Gauge incorporating optimum horn antennas designed

at NRC. Number of units sold or price is unknown.

(3) Haley Industries Limited -

Initial tests and consultation at NRC led to the development of a new method for preparing sand molds for casting.

Thirteen articles have been published in professional journals since 1968 and eight patents on microwave heating have been granted.

The royalties that have been earned to date amount to about \$12,000. Market acceptance has been delayed by patent infringements which are being fought.

EAR DEFENDERS AND EARPHONES

In the early 1950's the Division of Applied Physics embarked on a program of work on the conservation of hearing. The first success was the invention of the liquid-filled cushion for ear defenders (muffs), the performance of which is still unequaled twenty years later. Its use is growing rapidly in the wake of recent legislation that sets mandatory limits for exposure to occupational noise in most industrialized countries. The scale of use can be judged from the royalties for ear defenders and earphones earned by Canadian Patents and Development Limited. These amounted to approximately \$58,000 in 1974 and totalled almost \$640,000 during the life of the patent. In that year, the final year of the cushion patent, the Canadian licensee held a modest but respectable share of the world market for hearing protectors (probably between 10 and 20%).

A related invention, the improved earphone, which combined hearing protection with excellent frequency response, set a fashion in earphone style which is now ubiquitous in the high-fidelity acoustics. For more than a decade, earphones were manufactured under patent in Canada and the United States, but Canadian production ceased in 1975.

The Division of Physics continues to make basic contributions to hearing conservation which are unique and highly valued throughout the scientific world. For example, in 1974 the acoustic behaviour of the human external ear was clearly analyzed for the first time. In the next few years, this contribution to basic science is likely to have a significant bearing on the measurement of noise exposure and hearing loss,

and on the design of hearing protectors and hearing aids. Indeed the value of the entire program should be measured principally in terms of the vast number of people whose hearing has been conserved as a result of this work in the Division of Physics, together with the corresponding economic and social benefits which Canada is sharing with many other countries.

Welded Rails for Canadian Railway Operations

As implied in the previous note, the procedure for long rail welding was, in 1968, on the point of coming into general use. Since that date, a Canadian company has been licensed to manufacture the general apparatus for general sale in Canada and abroad and the Canadian railways are proceeding with the practice to the limit of their track improvement budgets.

Two important further developments have arisen from the association with rail transport problems. The first of these is the necessity to prevent heavy snow and cold weather from putting rail switches out of action. The issue is particularly serious where central traffic control involves a minimum of maintenance people in the neighbourhood of the switches themselves: it is severe in very large yards.

In order to deal with this problem, a variety of new switch heaters have been developed and put into experimental service on the Canadian railways. And a later development to save fuel and in order to avoid local thawing of frozen road bed, is the use of a pneumatic switch clearer. Alternatively in order to avoid the need for substantial quantities of electrical power at remote locations, two new forms of rail switches have been designed, made and tested in service and have been successful in avoiding failure by ice and snow without any melting or air clearance. (See new case history (February 1976) page 317.)

The heaters and blowing systems have been or are in the course of being licensed for manufacturing. The second form of programmes arising from the welded rail work, is a profound investigation into the dynamics of running of cars on a track, especially as they effect smoothness of operation, wear and risk of derailment. To this end, there is under construction a rolling and dynamic shaking simulator which is unique in being the first in the world to simulate curves.



Government
Publications

FIRST SESSION—THIRTIETH PARLIAMENT
1974-76

THE SENATE OF CANADA
PROCEEDINGS OF THE
STANDING SENATE COMMITTEE ON
SCIENCE POLICY

The Honourable MAURICE LAMONTAGNE, P.C., *Chairman*

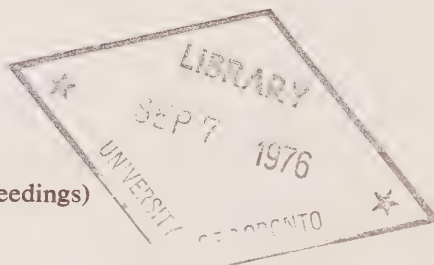
Issue No. 15

TUESDAY, AUGUST 10, 1976

Fifteen Proceedings on

**The Study of Canadian Government and
other expenditures on scientific activities
and matters related thereto.**

(Witnesses and appendices: See Minutes of Proceedings)



THE SPECIAL COMMITTEE OF THE
SENATE ON SCIENCE POLICY

The Honourable Maurice Lamontagne, P.C., *Chairman*

The Honourable Donald Cameron, *Deputy Chairman*

and

The Honourable Senators:

Asselin	Hastings
Bélisle	Hicks
Bell	Lang
Blois	Manning
Bonnell	Neiman
Bourget	Riel
Buckwold	Robichaud
Carter	Rowe
Giguère	Stanbury
Godfrey	Thompson
Goldenberg	van Roggen
Grosart	Yuzyk
Haig	

27 Members

(Quorum 5)

Order of Reference

Extract from the First Report of the Special Committee of the Senate on Science Policy, presented on July 10, 1975 and printed as an Appendix to the Minutes of the Proceedings of the Senate of that day, and adopted by the Senate on July 24, 1975:

"The Committee, therefore, recommends that it be authorized to consider and report on Canadian government and other expenditures on scientific activities and matters related thereto;

That the Committee have power to engage the services of such counsel and clerical personnel as may be necessary for the purpose of the inquiry;

That the Committee have power to send for persons, papers and records, to sit during adjournments of the Senate and to report from time to time; and

That the Committee be authorized to print such papers and evidence from day to day as may be ordered by the Committee."

Robert Fortier,
Clerk of the Senate.

Minutes of Proceedings

Tuesday, August 10, 1976
(25)

Pursuant to adjournment and notice the Special Committee of the Senate on Science Policy met this day at 9:35 a.m., the Chairman, the Honourable Senator Lamontagne, presiding.

Present: The Honourable Senators Bell, Bourget, Cameron, Lamontagne, Lang and Yuzyk. (6)

Present but not of the Committee: The Honourable Senator Lafond. (1)

In attendance: Mr. Philip J. Pocock, Director of Research, and Mr. Jacques Ostiguy, Chief of Administration.

The Committee resumed consideration of its Order of Reference dated July 24, 1975 relating to the study of Canadian Government and other expenditures on scientific activities and matters related thereto.

The following witnesses from the Department of Agriculture were heard:

Dr. B. B. Migicovsky,
Assistant Deputy Minister (Research);
Dr. D. G. Hamilton,
Director General,
Planning and Evaluation Directorate.

The Chairman made an opening statement during which he enumerated six documents which were sent to the Committee by the Department of Agriculture.

On Motion by the Honourable Senator Bourget it was Agreed that the letter, dated February 10, 1976, sent to the Chairman of the Committee by the Honourable Eugene Whelan, P.C., Minister of Agriculture, and the first eleven pages of a document entitled "Research Branch Program, dated December 9, 1975" be printed as appendices to this day's Minutes of Proceedings and Evidence. (*See Appendices nos. "27" and "28"*)

Dr. Migicovsky made a statement. The witnesses then answered questions put to them by Members of the Committee.

At 12:30 p.m. the Committee adjourned until 2:30 p.m., Tuesday, August 10, 1976.

ATTEST:

Patrick Savoie,
Clerk of the Committee.

The Special Committee of the Senate on Science Policy

Evidence

Ottawa, Tuesday, August 10, 1976.

The Special Committee of the Senate on Science Policy met this day at 9.30 a.m. to consider Canadian government and other expenditures on scientific activities and matters relating thereto.

Senator Maurice Lamontagne (*Chairman*) in the Chair.

The Chairman: Honourable senators, I want to say to those members of the committee who are present here this morning that they should be congratulated for their courage, enterprise and devotion. I know that some senators were planning to be here this morning and then at the last minute could not make it, while others will be able to be with us only this afternoon. This is rather an unusual time for us to meet, but I think it will enable us to make more rapid progress towards the completion of our hearings.

This week we will hear, to start with, four government agencies, namely, Agriculture Canada; Environment; Energy, Mines and Resources; and Atomic Energy of Canada Limited. Together these four agencies, according to my figures, spent at least 40 per cent of the total federal expenditures on research and development in the natural sciences in 1975-76.

We are starting this morning with Agriculture Canada which is represented by Dr. B. B. Migicovsky, Assistant Deputy Minister (Research), who is on my right, and then on his right is Dr. D. G. Hamilton, Director General, Planning and Evaluation Directorate. We are facing a rather unusual situation this morning because the Department of Agriculture has not submitted a specific brief to us but has made available instead a series of reports most of which were described in the letter to me from the minister, the Honourable Eugene Whelan, dated February 10, 1976. First of all, there is a document prepared on the current program of the Research Branch, dated December 9, 1975. Then there is a revised document—a display—and a review of the program of the Research Branch. Then secondly we have another document including nine case histories, according to the minister, of significant completed research projects as requested in Volume I of *A Science Policy for Canada*. Thirdly, there is a description of our operating grants programs at universities, our contracting program with industry and universities, and Agriculture Canada's extramural research programs with universities. The fourth document is a Research Branch report by program for 1974; and the fifth is a Research Branch report by stations for 1974.

Senator Bourget: Mr. Chairman, we did not receive copies of those reports.

The Chairman: Well, I hope they have now been made available.

Senator Bourget: Not that I know of, Mr. Chairman, and that is the reason why our questions will be based on the previous proceedings of our Committee in 1968.

The Chairman: Well, Senator, I am not responsible for the distribution. But I know from past experience that distribution has been made and very often these documents have been lost.

Senator Bourget: Well, they were not lost in my office. I am sorry. I am not blaming anybody.

The Chairman: We might mention as the sixth document the Research Branch Program Review, 1975, and this one I have not seen until this morning. This document was sent to us in April.

In the letter which I have just mentioned from the minister he states that the Research Branch of Agriculture Canada is the largest research organization in Canada. For that reason, and for others, I find it rather regrettable that this largest research organization has not followed the pattern of other agencies and has not prepared a specific brief for our consideration. This, in turn, raises a problem with regard to the printing of our proceedings. So, under those unusual circumstances, since we have no specific brief, I would suggest that we attach as an appendix to the report of these proceedings the letter we received from the minister dated February 10, 1976, and I would suggest that we should also print the first 11 pages of this document entitled "Research Branch Program" dated December 9, 1975. I think this book would be more suitable to print as an appendix to our proceedings.

Senator Bourget: I so move.

Senator Yuzyk: I second that.

Hon. Senators: Agreed.

The Chairman: Honourable senators, before we begin to question our witnesses, I shall ask them if either one of them wishes to make an opening statement.

Dr. B. B. Migicovsky, Assistant Deputy Minister (Research), Agriculture Canada: Yes, Mr. Chairman, I would be pleased to.

As you are undoubtedly aware that research for agriculture was started by the federal government in 1885, approximately, and has been operating under an act, the Experimental Farms Act. It has grown considerably in the intervening years, and it is considered to be rather different, in my opinion, from research done for any other area or industry, for a number of reasons.

I have read the documents that the Senate has produced with a great deal of pleasure, and I am very pleased to see the in-depth coverage that has taken place covering the whole area of science. Throughout those documents and in much of the material that has been written, when we talk

of "make or buy" policy or any other policy we speak of industry, and very often we neglect to look at the fact that agriculture is an industry, but it is one which is very unlike any other kind of industry. It is structured differently; it is not a single industry; it is a conglomerate of many industries. It has only one thing in common, and that is that it produces food and fibre. But foods are of many very different types requiring very different types of technology. Also agriculture as a conglomerate of industries is not represented by large companies as would be, for example, the electronics industry or the automotive industry.

We have in agriculture some 400,000 or 350,000 farmers who are, or whom we consider to be, the clients of the Research Branch of the department. Therefore we have different kinds of problems and different techniques that have to be used in terms of technology transfer and also in terms of understanding and stimulating activity in the industry by means of research. You cannot handle the wheat producing industry as you would handle the automobile industry or the electronics industry or any other manufacturing industry, or even the food processing industry. One has to look at one's client very carefully, and here we have a very different deck of cards.

In trying to give research service to agriculture a few years ago we embarked on a system of management by objectives. This was the rage some eight or 10 years ago, and we all attended seminars—and the chairman has done so, I know—where we argued and spoke on this subject of program planning budgeting and management by objectives. We looked very, very carefully when I became Director General at that time, and we adopted that part of the principle of management by objectives that would be of use to us in operating research for agriculture in Canada, recognizing at the same time that a large and important portion of the research done was carried out by universities, some by provincial governments and a very little by industry *per se*, except, possibly, in the food processing industry. But in the production of agricultural products industry plays a very minor or negligible role in terms of research.

The other fact that stood out was that, according to the BNA Act, education is a responsibility of the provinces, and therefore the transfer of technology, which is an educational process, or an agricultural extension, as we call it in Agriculture, was recognized to be a provincial responsibility. Nevertheless, although we never showed it in our budget, and we have not hired what we call extension specialists in the Research Branch, approximately 3 or 4 to a maximum of about 5 per cent of all our activities are really extension activities to supplement those extension activities that take place in the provinces, realizing that some provinces do it better than others.

We nevertheless felt that we had to play a role here, and still do, and probably will have to continue to do so. It would be much more to our advantage if we had the extension operations of the provinces more closely associated with our research facility. Recognizing this, in many of our stations we do house provincial extension staff in the same building, so that we would be in bed together, so to speak, and be able to transfer the technology more readily. We have always recognized that research without the transfer of technology might just as well not be done. This has been a byword of our operation, and will continue to be so.

In the application of management by objectives I think we have made more progress than any other department,

in that we have adopted it fully, we have documented it, and it operates very well for us. However, that does not necessarily mean that it will operate the same way for others. We have adapted it to our particular situation. We have listed our objectives and tried to relate them to what is often referred to as government aims or government objectives as they come out to us in the Speech from the Throne or other areas. Naturally, in agriculture most of them are production oriented, in that we try to improve the productivity of the agricultural sector by means of research. We have not, in our branch, not in the department, sufficiently addressed ourselves to the social aspects or consequences of our research. This is now being done by a study being carried out on the future orientation of agriculture in Canada, and we hope to have that ready by the end of this year. We have a steering committee, of which I am the chairman, and we are involving some 100 people within the department. When we come up with our first draft we will then see whether we have to go to outside consultants, if necessary.

The Chairman: Do you intend to make this study public?

Dr. Migicovsky: At this moment I am not in a position to say. We will take a look at it. If it is worth being made public, I sincerely hope—and I think it will be the case—we will make it public. However, we will not commit ourselves until we see how good it is. In other words I am never going to publish my book unless I have read it and reviewed it, and I have not even written it yet.

There have been many conversations between ourselves and other departments, particularly the National Research Council, and we are now embarked on a program called Food 2000. We have been in touch with MOSST on this, and MOSST is now going to be the lead agency to bring together those departments that deal with research bearing on food, which would include the Departments of the Environment, National Health and Welfare, ourselves and Consumer Affairs. We have the skeleton of this study prepared by our experts and those of the National Research Council, and we hope to have a document ready soon, which will probably take the form of a memorandum to cabinet, if we manage to set up this task force. We are just trying to look into the future.

The Chairman: I am sure we will see that one.

Dr. Migicovsky: If you don't see it we may as well not do it.

The Chairman: All cabinet documents are leaked!

Dr. Migicovsky: You will probably see it before it gets to be a cabinet document, if I know what is going on around here!

That document is an attempt to look into what is required in terms of research in the biological and physical sciences for food needs as we see them, for both our export and domestic requirements. We try to cover the waterfront here, and we have an outline ready. We are due to have a meeting with MOSST within a matter of a week or two, with all these other departments, to see how they react, and to see whether we can get the necessary expertise together to do this kind of study. I am sure we can, and I hope to have that launched with Dr. Schneider and senior members of the other departments.

The Chairman: According to the new terminology you would be the lead agency.

Dr. Migicovsky: This is yet to be decided. It looks as though in that one we will be the lead agency. There are other studies going on in which we would not be the lead agency. Our grave concern now in terms of the safety of foods and substances that are released to the environment is that, as you are well aware, Agriculture has a responsibility, because it does register substances that are released to the environment, which may or may not be considered toxic. After our experience in New Brunswick with Rye's syndrome—both Dr. Schneider and I, among others, were on that panel—we tried to advise the Government of New Brunswick what to do.

Situations have occurred in local spots throughout the world, where people have died, allegedly due to something they drank, ate, breathed or goodness knows what, which nobody has been able to pinpoint. There is obviously a vast store of ignorance that we are facing in the areas of toxicology, using the word "toxicology" in a very broad sense. What has come up on the horizon is that, not only must you worry about the toxicology or the poisonous quality of a particular substance or biological agent, a bacteria or a virus, but you now have to be concerned about the possible synergistic action, or the action that takes place when two or three substances come together, all of them unknown, and produce a result which any one of them would not produce. You are raising subjects about which scientists know nothing.

Certainly in Canada we have a very minimum of expertise in toxicology. The only way of developing it is at the universities, with help from government laboratories, and certainly with enough money. I do not know where there is any other source of money. A meeting is being held within a month to deal with this subject. Here we are suggesting the National Research Council take the lead, because it is the only unbiased agency; Environment obviously has a bias, Agriculture has a bias and Health has a bias, although we are certainly deeply interested. We hope we will launch something here in which the National Research Council will be the lead agency. We are involved because we have to protect our crops and our animals, otherwise we cannot produce food. At the same time we are even more anxious that in the act of protecting these crops and animals we do no harm to the population or the environment which would spoil its quality. We are just as conscious of this as are those who are responsible for health. We certainly cannot put out products and use substances which would put our ministry in a very embarrassing situation and at the same time would certainly be harmful to the population at large.

I am sorry that you have not received all the documents. You will find that we have a very comprehensive program of research. At the moment we spend approximately \$100 million, which amounts to approximately 1 per cent of the agricultural income in Canada. That is not a large sum of money in terms of research. I firmly believe that the agricultural community, if not the community at large, appreciates and is continually demanding that we do more, for if anyone leaves one of our stations there is always a host of letters indicating the hope that the individual will be replaced and the position will not be moved to some other part of the country. There is pressure to do a great deal more in all areas.

I wish to make one last statement: In our operation of management by objectives we have thrown out the term—we do not use it; we abhor it: basic, applied or development. We cannot define to the satisfaction of the scientists, the administrators and the public the meaning of these

terms. I attended a number of seminars sponsored by the Science Council. We sat for weeks and a book was written. Everyone came out by the same doorway wherein they went. They had a preconceived notion of what is basically research or applied and they did not come out with their minds changed. I take the attitude that research is a spectrum with the basic at one end and how we do development research at the other. No one type of research deserves one status more than another and in terms of science for society this spectrum cannot be split. Basic, at one end, must lead into the other, or it must feed back. Therefore, in agriculture we do not divide our program into basic, semi-basic and applied; we say only that it is all oriented or relevant to agriculture as we see it. Now, sometimes it is relevant to more than agriculture, obviously, because science is of that nature. A great deal of the research done in agriculture is very relevant to health and certainly to environment and energy, and so it should be. We take great care in terms of our knowledge of the operations throughout Canada that we do not step on the toes of each other. I believe duplication to be at a minimum and if a small amount of duplication takes place, in my opinion it does not do a great deal of harm. It serves to confirm the findings brought out.

With that short statement, sir, I am open for questioning.

The Chairman: Thank you very much.

Senator Yuzyk: Mr. Chairman, the representatives of the Department of Agriculture first appeared before our Science Policy Committee on November 21, 1968. They were among the first to give evidence shortly after the Senate Special Committee on Science Policy began its inquiry. During the past eight years many changes and developments have taken place, many of which have brought about improvements, we hope, in agricultural services, as well as in the applications of science for the benefit of Canadians. We would like to discuss and analyze some of the significant changes and assess their implications and results.

The Department of Agriculture now has the name Agriculture Canada. As a matter of interest I would like to find out about the changes in the positions of the members of the delegation who appeared as witnesses on November 21, 1968. I note that Dr. Migicovsky, then Director-General, Research Branch, is now the Assistant Deputy Minister in charge of Research. This can be regarded as upward mobility, and we would like to congratulate him on this elevation. He was a very important witness eight years ago and we are glad to have him with us today.

What has happened to the following officials: Mr. Sydney B. Williams, the former Deputy Minister?

Dr. Migicovsky: Retired.

Senator Yuzyk: Dr. Woodward, who was then Assistant Deputy Minister in charge of Research?

Dr. Migicovsky: Retired.

Senator Yuzyk: Dr. Glenn R. Purnell, former Director-General of the Economics Branch?

Dr. Migicovsky: Resigned.

Senator Yuzyk: Dr. Arthur J. Skolko, former Co-ordinator (Plant Pathology), Research Branch?

Dr. Migicovsky: Retired.

Senator Yuzyk: Dr. Kenneth F. Wells, the Veterinary Director-General at that time?

Dr. Migicovsky: Retired.

Senator Yuzyk: What position did Dr. Hamilton hold in 1968?

Dr. Migicovsky: Dr. Hamilton at that time was Assistant Director-General for the eastern region in the Research Branch and is now Director-General, Program Planning.

Senator Yuzyk: I see that time takes its toll, does it not?

Dr. Migicovsky: It does.

Senator Yuzyk: During this time the Science Policy Committee has issued three volumes of its report. One of its most important recommendations has been implemented and has brought about a very important change in the right direction, we are convinced. The Ministry of State for Science and Technology, MOSST, has now been in operation for several years. One of its principal functions is the co-ordination of the scientific activities of various federal ministries and departments. What has been the experience of Agriculture Canada with MOSST?

Dr. Migicovsky: We have met with MOSST on numerous occasions, more often during the past two or three years. Now, whenever a subject arises which involves the interest of several departments we use MOSST as the central focus to bring us together. They provide the chairman, and, usually, the secretariat and tend to implement, if you will, the ideas that come out from several departments. The outline which I gave you with respect to toxicology is an excellent example of this, because at the moment the four assistant deputy ministers will sit down and decide yes, this is important, the degree of importance and the amount of moneys, approximately, which can be considered. We will then go to MOSST. In fact, MOSST will have an observer at this meeting of the four assistant deputy ministers. It will be up to them to—I hate to use the word “co-ordinate,” but rather to coalesce the ideas coming from the four departments so that we can go to government with a single program in which four departments have an interest and which will obviously require additional or new funding. MOSST will then help us carry the ball and decide on the technical manner or the strategy of bringing this forward in order to bring it to fruition. It is in this area that MOSST plays an important role.

Now we have the whole area of “make or buy,” for example, in connection with which we were all involved at a number of meetings concerning this particular document, which went through as a memorandum to Cabinet. I recall the last draft I looked at was the eighth or ninth draft of this document. There were disagreements among the departments as to the wording or the general nuances contained in that particular document. We made our opinions known to them and many of them were introduced. We then went to the meeting of the Cabinet committee to speak our minds before we had the present document, which just came out, with respect to “make or buy,” which is a very important operation with respect to science in Canada and was originated in these documents. The important thing that we discovered about this was that we were able to sell MOSST on the idea that we cannot apply “make or buy” as a formula applying to everything and everyone. It must be adjusted to the particular needs and requirements of individual departments who have differ-

ent roles to play and different customers to serve, if you will.

Senator Yuzyk: I am glad to hear that you find MOSST very useful. Would you care to make any suggestions as to how relations between Agriculture Canada and MOSST could be improved?

Dr. Migicovsky: They are very good presently. One improvement I have in mind with respect to MOSST would require legislation and an increase in manpower. One of the grave difficulties is that there is no external review of our programs, and this is common to all government departments doing a great deal of research. We do 65 per cent of the agricultural research in Canada, spending \$100 million. Having been brought up during the depression, \$100 million, although today not considered a great deal of money, is, to my way of thinking, an awful lot of money, and apart from the review commenced by this committee, there is not one single external review as to how that \$100 million is spent. I am referring now to the nitty-gritty of it. We spend so much on wheat, so much on apples, so much on beef, in terms of our objectives, and we separate those objectives in terms of goals, as Dr. Hamilton will outline.

No one really looks at our programs other than ourselves. Dr. Hamilton and his staff of experts, some 14 in all, carry out an internal review of programs and we look at it very hard and try to make shifts, as best we can. As you know, shifting from one place to another is difficult in Canada. Canada is a very difficult country to govern in this regard, but we do the best we can in shifting programs and changing our priorities, as circumstances warrant. But no one from the outside looks at our programs, or even selects a portion to examine with a view to either proving us negligent in some regard or giving us a pat on the back for a job well done in a certain area. There is no criticism whatsoever, either positive or negative. That is one area where MOSST could play a role, if it had access to expertise. They could buy that expertise, I suppose.

Whether the rest of the departments would like to have an external review of this kind, I do not know. I do not know whether Bell Telephone has such a review, or other companies. But we are not Bell Telephone. We are government people responsible to the taxpayers, and I am of the opinion that the taxpayer must have a means by which he can determine whether the moneys being spent are being spent properly.

Naturally, there will be disagreements. Beef producers will want more spent on beef; wheat producers will want more spent on wheat; fruit producers will want more spent on fruit. This will always occur. But we feel there should be some knowledgeable people who can look at our programs with a view to categorizing our research as being good, poor or mediocre. Nothing like that has taken place during my time in government, which runs over a period, both military and civil, of 36 years.

The Chairman: By way of supplementary, we were told by MOSST that it was now getting into the position where the different departments and agencies would submit their proposed expenditures on R&D and it was getting prepared to examine those proposals and give advice in a way that you have indicated to the agency or department concerned and, more specifically, to Treasury Board. Is that kind of influence beginning to be felt?

Dr. Migicovsky: If it is advice based on information suitably obtained, made by people who understand that

information, the answer is yes. With the staff as it is presently constituted, better it not be done. It is bad enough to have Treasury Board doing it without the benefit of the necessary expertise. It would have to have a staff many times its present size, with expertise in the various disciplines involved.

I do not want someone coming into my show to discuss the soils research program when that individual does not know soil from rock. He would have to be a soils scientist if he is going to look at the details of that program with a view to constructively criticizing it. In the same way, I would not attempt to go into the Art Gallery with a view to criticizing the head of that gallery for the works of art that have been accumulated.

Senator Bourget: Would you recommend that there be a permanent attaché from MOSST in your department with a view to following up these programs?

Dr. Migicovsky: One permanent attaché could not possibly do this job. Agricultural research takes in every possible scientific discipline, to say nothing of it covering every possible product, and every product constitutes a different biological unit. If you are talking about protection of crops, there are 30 or 40 crops and hundreds of pests, including several hundred diseases. How could one man, who may be an expert on wheat breeding, cover this kind of program? It is difficult to do, but I think there are ways in which it can be done. The whole program does not have to be covered. The department could be made aware that one of its objectives is going to be covered, and the necessary experts could be acquired to interview departmental officials, visit the laboratories, talk to the scientists, and come up with a review of a part of a program.

I am not worried about people examining my budget. I have no difficulty whatsoever in convincing Treasury Board as to how I allocate the budget. The amount of money provided by Treasury Board is not so much related to how important research is, but how much money the government has to spend on research. Usually, the historical pattern prevails: What did you spend last year and the year before? Can we afford to spend 1 per cent a year more?

Treasury Board is now sensible enough not to specify how a budget should be spent. It will illustrate what it feels is important and will then leave it to the individual departments to decide how their budgets are to be spent. After all, we are just as devoted to Canada as Treasury Board officials, and I think we know more than they do as to where our research funds should go. I think Treasury Board recognizes that.

Senator Yuzyk: I wonder if I could ask Dr. Hamilton, the Director General, Planning and Evaluation Directorate, about his experience with MOSST. Do you have any permanent arrangement with MOSST to review the work that you plan and are or will be doing?

Dr. D. G. Hamilton, Director general, planning and evaluation directorate agriculture Canada: We have no permanent arrangement, but I can give you an example of how we do interact with MOSST, and I think it is getting better all the time.

Where programs cut across several interests and several departmental aspects, I think MOSST gets very, very real. Only this morning, I signed a final document to go to MOSST. We had been dialoguing with officials of MOSST

for a few weeks and with people outside, too, as to whether Canada should have a biological survey—only part of the job in this regard is being done—of the insects and the fungi and the flora of Canada. That is a tremendous job yet to be done.

If we were left with our ordinary budget, it would take us the next 100 years. What are we going to do? The National Museum is very much interested, as is the Department of the Environment, Parks Canada and Agriculture Canada. Agriculture Canada has the lead position in keeping the national collection, which it has always had responsibility for, and identification services.

We have had quite a few meetings with MOSST on this, and I think we are going to finally get all the groups together so that before too long we will know what we are trying to accomplish as an entity. MOSST participates in these meetings and will coordinate the program as to cost and how and when it will be put into effect.

If we are building a new building and we have to get ready a long way ahead, what is the staffing of that building or program going to be once it is in place? What are the "make and buy" parts of that program? How is it going to change the present program? We dialogue those things right back to the beginning with MOSST, and MOSST then advises the Treasury Board that this thing is heading, in their view, in the right direction and that the plans are carried forward as they are anticipated, and they then think that the facilities should be supported. There is that kind of thing, and in many of these proposals, whether they are for contracts or whether they are for our specific proposals, MOSST is there at all of the meetings we have, and of course we are now involved in interdepartmental committees that MOSST fosters and pushes. There is one on technological planning, which I am involved in, which keeps our group pretty closely involved with all of the departments, with what is going on in government policy thinking and the institution of public policy. I think our associations with MOSST are very close, but we have to provide the answers when it comes to agriculture and carry them out.

Senator Yuzyk: In other words, there are good relations between Agriculture Canada and MOSST?

Dr. Hamilton: Yes, they are helping each other.

Senator Yuzyk: And they are improving?

Dr. Hamilton: Yes. I mean, they are not trying to push each other.

Senator Yuzyk: There is a good spirit of co-operation?

Dr. Hamilton: I find that.

Senator Yuzyk: Well, we are very glad to hear that. Agriculture Canada works very closely with 11 faculties of agriculture and veterinary medicine in Canada. In 1974, I believe, these faculties issued a pamphlet presenting their national statement under the heading "The National Context", in which the goals of agriculture in Canada are outlined, which of course we know of in general. Particular attention is devoted to the energy crisis, an alarming situation at that time. I would like to read this important paragraph:

A shortage of physical energy resources makes it imperative that agriculture's intellectual resources be exploited fully and efficiently. This is not now being done in Canada.

Out of about \$1.5 billion a year spent on scientific and technological research, agriculture and its related sciences get much less than 10 per cent. For want of staff or funds, needed research projects that promise high payoff simply do not get started.

Reference is made to the publications of the Science Council of Canada regarding the specific problems of science in agriculture. It was identified that "the lack of co-ordination of research, particularly between the federal government and the universities is a fundamental weakness of the whole system". The quality of research done by Agriculture Canada, the provincial government and the food industries was not in question. It was recognized that a national committee for co-ordination did exist but it was ineffective and it lacked adequate powers. The deans of agriculture and veterinary science endorsed the proposal of the Science Council that a representative agricultural and research co-ordinating council with significant budgetary powers be established without further delay. Has there any progress made in this matter?

Dr. Migicovsky: I will answer very quickly. In April 1975 the Canadian Agricultural Research Council came into being and a sum of \$50,000 was provided by Agriculture Canada to this council. The chairman was formerly the Dean of Agriculture at Guelph, Dr. Richards, and members are made up of representatives of deans of agriculture representing the deans of vet medicine and the faculties of agriculture, representatives of industry nominated by Boards, two representatives of business and two representatives from the large agricultural associations of Canada, the Farmers Union and the National Federation. In addition, we have representatives from the National Research Council, MOSST, and I believe there is a representative from DSS—the Department of Supply and Services—and, of course, representatives from Agriculture Canada. I sit as vice-chairman, and we provide the secretariat with the dog work that is required and, of course, the money.

Senator Yuzyk: It is now functioning?

Dr. Migicovsky: It is now functioning and we will have in place, hopefully by December, as well as we can do it within the time allotted, a complete inventory of agricultural research in Canada as conducted by universities, provincial governments, the federal government and what we can get from industry, and we have had a little difficulty in getting an accurate figure on the amount of research conducted.

The Chairman: What is the role of that council in relation to your organization? You said a moment ago that there was no process to make an external review of your operations?

Dr. Migicovsky: All right. Now this is coming into being; it is one of the things what we are trying to do this year. They have selected three topics which they are going to review. We said we did not have the kind of money with which we could hire large numbers of consultants, but they are going to appoint people, from universities and other places, to study specific topics. One of them, for example, is rapeseed—rapeseed research. This is a research council, and they will look at the progress made with respect to this, and the direction in which they think they should go in terms of rapeseed.

Energy is another one, and land use. That is the gathering of information, research information, so that anybody

who is formulating a policy hopefully will get better and more information on which to base that policy. I think it is the duty of the researchers to produce that kind of information, not to make the policy.

The Chairman: How often do they meet?

Dr. Migicovsky: Well, they have been meeting now ever since they have been organizing, and the idea is that the whole council will meet about four times a year. The executive body of the council, the smaller group, will meet much more frequently, and subgroups that are formed in order to deal with specific jobs will meet as required in order to carry out the job. For example, the subgroup that was drawing up the inventory met quite frequently at the beginning, and less frequently after they had set it up, and now the group that they are going to set up to study rapeseed, for example, will meet as required. It is up to that group to present us with a report that we will in turn examine and present to the body which answers, and that is the body called CASCC, which is the Agricultural Services Co-ordinating Committee, which is made up of the deputy ministers of agriculture of all the provinces, plus the Deputy Minister of Agriculture of Canada, plus deans of agriculture, with a few other members from other parts of the country.

The Chairman: But this council will report to the committee?

Dr. Migicovsky: To CASCC, and it will tell us that our research on rapeseed is not enough, or it is good, or it is bad, or it is indifferent, or whatever the case may be. These are the directions in which we think that money should flow.

Of course, we also have, as you know, under CASCC, what we call Canada committees, which deal not only with research—which many of them do—but which review certain areas and advise CASCC on what should be done. Usually that requires funds, and we can only respond in terms of our ability to get funds to carry out their suggestions.

The Chairman: Perhaps you could refresh our memory as to what are the responsibilities of this co-ordinating committee of CASCC.

Dr. Migicovsky: You mean the Canadian Agricultural Research Council?

The Chairman: Yes.

Dr. Migicovsky: The Agricultural Services Co-ordinating Committee?

The Chairman: Yes.

Dr. Migicovsky: It is answerable to itself. It is made up of deputy ministers and its responsibility is to review the delivery of services to the agricultural community by certain types of extension. Research is one of these services, as is information transfer and many of the services that are delivered by governments to the agricultural community. They review those and make recommendations to themselves as to what should be done to improve them or introduce new types of services that have not been introduced to date.

Senator Bourget: On that particular question, how are the provinces playing a role in that committee? Does the committee have representatives from the provinces?

Dr. Migicovsky: The Deputy Minister of Agriculture of each province is a member and, in addition, he brings his experts with him and they sit in with him at these meetings.

Senator Bourget: And what about industry and the universities?

Dr. Migicovsky: The universities are represented, as is the Federation and the Agricultural Institute of Canada.

Senator Bourget: And that is your main coordinating committee?

Dr. Migicovsky: That is the main coordinating committee for agriculture in Canada. It must be added that functioning under this there are agricultural coordinating services committees in each province which coordinate activities within the province, and they make recommendations to the central body as to the kind of services required in that particular province—services which may not be required in other provinces. As you are well aware, climate is extremely important where agriculture is concerned, and you know what we have in terms of climate and geography in this country. In the Maritimes the story is very different from that in Saskatchewan, while in Quebec it is very different from that in British Columbia. Each province has its own particular requirements, and therefore it is funnelled from each province into this central body.

Senator Bourget: Do you meet often?

Dr. Migicovsky: The committee meets once a year as a body.

Senator Bourget: Is that often enough?

Dr. Migicovsky: Oh, yes, because you have all the other committees that answer to it, in addition to the Agricultural Research Council which answers to it. Furthermore they can set up any particular kind of sub-group to do a particular study, and this sub-group will also answer to it. So I think once a year is enough.

The Chairman: I am beginning to wonder, with all these committees with representations from the agricultural community, why is it that the farmers are so mad in our country?

Dr. Migicovsky: Well, Mr. Chairman, I could go into that question at length, but I do not think we have time. The fact is that over the many years that we have been in existence Canadians have eaten very, very well and the agricultural industry has produced all that it had to produce. The fact that sometimes farmers are not making as much money as we think they should make, or, for that matter, as they think they should make, is another problem. You will realize it goes far deeper than anything we are going to be able to look into here. I feel very bitter about the fact that the agricultural community has not made the kind of money that it has deserved to make, and I do not think that the public of Canada is fully aware of the kind of service they have been getting from the agricultural community. If you raise the price of meat one cent a pound you get a headline in the *Globe and Mail*, but if you reduce the farmer's income by 15 per cent you do not hear too much about it. It is only of late the farmers have begun to speak up for themselves. I think we have committed a very grave injustice to farmers in Canada over the years and are doing so right now.

Senator Bourget: I should like to come back to a question asked by Senator Yuzyk, and I should like to ask how that \$100 million is spent. Could you give us a breakdown of that sum in terms of salaries and so on?

Dr. Migicovsky: I will turn that question over to Dr. Hamilton. Having anticipated this kind of question, we can give you the information in any way you want.

Senator Bourget: Well, just a general breakdown will do.

Dr. Hamilton: Well, you know the \$100 million covers votes for salaries, votes for equipment, votes for operations. We have 47 establishments across the country and when we get the \$100 million we have to break it down to take care of the operations in each of these establishments, whether it be a large one with 30 or 40 scientists or a very small one. I looked at this figure of \$99 million.

The Chairman: Is this the latest figure you have? Is it the figure for 1975-76?

Dr. Hamilton: Yes. I looked at one of the latest books. I find that the supporting services take about \$33 million, administration takes about \$5 million, and then in the way we break down the budget for Treasury Board we find that we have about \$6 million for soils, \$22 millions for crop research and of course soils and crops are put together in many of our objectives. In general biology we have \$12 million, and in engineering we have \$2 million. Then for animals we have \$12 million, and to supply the money needed for pensions and things like that we have \$6 million. We could give you this information by stations or in a breakdown like this, and while I do not have it with me I could give it to you by objectives and goals because we also break it down that way.

Dr. Migicovsky: Another way we could do it is this. If you were to ask us—as is done by the standing committee of the house—how much work we are doing in research on apples, we could give it to you in terms of man-years, and then by a simple formula we could transfer those man-years into dollars. It amounts, I think, to approximately \$60,000. But the important thing is the number of professional man-years being devoted to this. Because that is what gives you the progress—not necessarily the dollars. A professional man-year on animal research, for instance, is much greater than a professional man-year in theoretical biology, because you have to use large animals which require barns and all kinds of equipment. That is all pretty costly. But we can break that down, and in this review you actually have a fly sheet which gives the man-years on the goals, for example. We now have a new one which Dr. Hamilton has with him, and when we have it available we shall put it into this book and we will send you each a copy, if you so wish.

Dr. Hamilton: One thing I should say before we finish this part of the questioning is that about 60 per cent of this money goes for salaries and 30 per cent, approximately, goes for the ordinary day-to-day housekeeping, so we have very little left over to give us any flexibility whatever. We just have enough to pay the bills, the salaries, the operations, the lights. The money goes for those very things.

Senator Bourget: And that question leads to the next one: How much increase in financial support will you need per year, let us say in the next five years, in order to

maintain your established level of activity? Have you figured that out?

Dr. Migicovsky: Oh, yes, we can give you a number of figures. The established level of activity is retaining the activity we have today. Then, of course, comes the question of the reminder from my colleague, which is to look after the new things that we are being pressed to do. We would like to operate, as we once did, where we said we had a 2 per cent increase for a while. We have a plan that we are going to submit to Treasury Board which will enable us to increase the amount of manpower we have for one or two years, and then promise to go down by attrition, so that we do not have a curve of increase going up. That becomes absurd. You cannot keep increasing the amount of research and employing more people in the public service. I feel very strongly that the public service is large enough. I do not think Agriculture Canada is large enough, but the public service is large enough.

The Chairman: It is always the neighbour.

Dr. Migicovsky: That is right. What I think we need is a little more flexibility, not to increase our capability very much but to enable us to make the necessary changes that have to be brought about. Suddenly a new disease hits us and we have to do research on that disease. It is very difficult for us to bring in new people. We do not have the resources to bring in new people in order to do that kind of research. We have to transfer. As you are well aware, you cannot move people like you do things. This does not give us the kind of flexibility we need in order to do new research, to bring out new programs, or even expand old ones. Transfers are difficult. We do it, but it is difficult to do. Also, it is very difficult to fire in the public service. It is said that there are mechanisms by which you can do it. Departments have tried it in the past, to their very grave displeasure. It is difficult to take a man who has been with you 20 years and say, "You are not working in the right area. You do not have the right capability and we are putting you out to pasture." It can be done, I admit, but it is not done very readily, and it is not done very often.

I think we are kidding ourselves if we think we can do this as would a small company who can hire and fire at will. The government is not a company, and any time anybody uses that analogy I get very angry. Argument by analogy is idiotic. You cannot compare the Ford Motor Company with the Government of Canada. You can make a comparison of what they are like, but there are many differences. Nobody looks at the differences; they look only at the similarities, and you will not arrive at some sort of reasoning you can follow because of the similarities. It is absurd.

Senator Bell: On the question of flexibility and Dr. Migicovsky's reference to an outbreak, take a serious problem like blue tongue, which is occurring in British Columbia right now. If you do not have permanent staff who can suddenly cope with a big emergency like this, because salaries or budgets are frozen, what flexibility do you have for obtaining outside help, contract scientists? Can you bring them in?

Dr. Migicovsky: Yes, you can do that now; you can do research outside, get the research done outside, which we have done to a degree. However, you have to go to Treasury Board for that sum of money and justify it.

Senator Bell: But you do not have to worry about finding jobs for them afterwards, when the disaster is over?

Dr. Migicovsky: What you have to worry about is that the people you contract out to will be able to get the scientists to do the job.

Senator Bell: Are we training enough so that they can do that?

Dr. Migicovsky: I question whether we are training enough. If suddenly there was a need for plant pathologists, I do not know where they would find them; or if they need veterinarians, or veterinary researchers, I do not know where they would find them. What we do in a case such as blue tongue is that we simply mobilize; when there is an emergency we take people from all over the country and move them in, paying their expenses of course, in order to look after that emergency. There is no doubt about it. This happens all the time.

Senator Bell: If there is a fairly serious emergency you have the flexibility to bring in outside people?

Dr. Migicovsky: We have this flexibility; we can do it at any time, and we do it. Naturally it disrupts your whole program; it is very disrupting. We do this, but what we would like is the capability of looking after the holes that are made when we make the move. If you have a continuous program of what some people will refer to as research that is not directly applicable, and you take those experts and send them some place else to look after an emergency you disrupt the program. Are you going to leave it permanently disrupted? It is a very important program, not perhaps for this month or next month, but ten or fifteen years from now. Most of the benefits we now get come as a result of the research that we started ten or fifteen years ago.

Rapeseed is a very good example. When we started research on rapeseed nobody came to us and said, "Yes, it's a wonderful idea. Here is the money and manpower. Do it." We started it with a very, very small group, and only got the funds when we achieved some success. Nothing succeeds like success. Once you get success you can get funds and manpower. Then, of course, the universities will take this up, with funds that they get from the National Research Council and ourselves, in order to bring this Cinderella crop to the success it enjoys.

I would also want to point out with reference to universities, which has not been mentioned so far, that we were the only department that was enabled over the year 1975-76 to increase grants to universities by almost a factor of two. How we got this through Treasury Board I am not too sure. The department takes credit for it, of course, for having put up a very good argument. It went through, and we are very proud and pleased that we were able to increase the ordinary research grants to the universities.

Senator Bourget: What was the total amount of grants to the universities? Was it \$1 million?

Dr. Migicovsky: Yes, \$1 million.

Senator Bourget: Do you think it is enough?

Dr. Migicovsky: No. We are not, of course, essentially a granting agency, as you have reported yourselves. You have different techniques, and I agree with them. Granting agencies should look after it; departments should not be involved in general granting. I think we should be able to grant to a certain degree in order to meet our specific requirements at universities, but the general granting operations should be in the hands of the councils.

The Chairman: Since we are touching on that issue, I think it is important, especially in terms of flexibility, to mention this. I should like at one stage to come back to the so-called problem of the aging of researchers within the government. It is not clear from your presentations here what amounts in, for instance, 1975-76 were given to universities by way of grants.

Dr. Hamilton: In 1975-76 it went from \$650,000 up to \$1 million.

The Chairman: Grants to universities?

Dr. Hamilton: Yes.

The Chairman: Any contracts to universities?

Dr. Hamilton: We have extra-mural research grants to universities, which are set up more like contracts, that we have run like contracts for many years; they are not run through DSS; there is \$270,000 for that. In addition, a lot of our contract research is with universities. We try to get private industry to do it, wherever they are ready, and whenever they can do the kind of thing we are looking to have done, but a lot of it is with universities. Our total contract research now is approximately \$2.75 million.

The Chairman: How much of this goes to universities and how much to industry?

Dr. Hamilton: I would think to universities it is about 80 per cent.

The Chairman: It means, if my figures are correct, that out of a budget of \$106 million for 1975-76, which is the figure I have, you give approximately \$4 million to the support, either in terms of grants or contracts, of outside performers.

Dr. Migicovsky: That is correct.

The Chairman: Do you think this is a sufficient effort, in view of the fact that the moment you hire somebody in your labs you have problems, because of this human problem, which I understand very well? Has there been any study of this situation?

Dr. Migicovsky: Oh yes; we have agonized over it. Difficulties arise here. What comes first, the chicken or the egg? If we are not going to get any more money, how do you transfer the operations from government into industry and universities? I have not got an answer to it.

The Chairman: Because then you would have to move people.

Dr. Migicovsky: Because universities themselves say in their report from which Senator Yuzyk read that they recommend that we do not reduce the amount of research carried on by Agriculture Canada. The quality is good and we should not reduce the quantity, but they would like a greater share of the amount of research being carried on. The only way I know to do this would be by obtaining more money and giving it to the universities, thus enabling them to staff and to train graduate students to the Ph.D. level, hire them and thereby carry on more of the research. I see no other way. The only other way I can see would be to take whole programs, which I just do not know how to do, and give them to the universities. The program is not an individual but a group of scientists, technicians and experts spread throughout the country. The wheat program is not in any one place, but covers four or five stations. Are we to take all these people and say we will carry on the

wheat breeding in Agriculture Canada, but at two universities and ask the universities to take these technicians and others and we will provide to them the funds that we would normally spend in order to do that? Will that provide better research for Canada in terms of wheat breeding? I do not believe it will, although I am firmly of the opinion that there is unused talent at the universities and that we are committing a sin by not using it.

I am also convinced that it would be to the advantage of Canada as a whole if we were to produce more highly-trained individuals. This must be done in the universities and requires research funds. The training of a man to carry on research requires him to learn by doing it, but he cannot always do it in connection with the problems facing the country, which we must face. They must consider their *modus operandi* in a different manner than we. We are oriented toward solving a problem to a much greater degree than is a university, although they are also conscious of it. However, some of the research carried on by graduate students is primarily to train those graduate students. If we could at the same time solve the problems of the country and train the graduate students it would be done by contracting and grant money, but a great deal of that, obviously, would not be directed toward a relevant program particularly, although a great deal of it would be. I see no way of doing it, except to say that we will support universities to a greater extent and make the funds available to the granting agencies.

I say that we would do the country a disservice if we were to reduce the research carried on within Agriculture Canada unless we were to remodel the whole country.

The Chairman: In my opinion, it would be worth while to go into this at quite some length with respect to the problem of flexibility, the problem of contracting out and that of aging in our own labs within the context of budgetary restraints and so on. It seems to me that this is one of the most dramatic problems we must face, and it now exists in government establishments. We should, therefore, spend some time discussing it. In relation to that I have here a statement of Mr. Avery Sahl, who is a pool director and a Wheat Board advisory committee member, whom you probably know. He stated last April in a radio interview that in the United States and Australia a good deal of the research is carried out by private companies, co-operatives and those in industry. They also have government programs, whereas in Canada all our research effort is carried on by government.

How do you account for these differences between countries, these two other countries being really our partners, or competitors if you wish, on world markets?

Dr. Migicovsky: Well, we grew up differently and the statement is a little exaggerated, not all research is being carried out by Agriculture Canada. There are a few private breeders in Canada.

The Chairman: A moment ago you said 65 per cent was carried out by Agriculture Canada.

Dr. Migicovsky: Approximately.

The Chairman: So this statement is certainly exaggerated.

Dr. Migicovsky: Yes, because there are universities and certain private plant breeders. Stewart Seeds is a good example; Ailsa Craig in southern Ontario. They have received grants. I am on the industrial research assistance

program of NRC. We introduced quite a number of agricultural programs to be carried on by industry, of which he is one example. He has been successful, particularly, with respect to his corn hybrids. However, he has just been taken over by CIBA-Geigy. I recently visited their operation, which is very nice and they are very happy with the support they receive from government.

We just have not built up within industry that type of capability which these other countries have. There is a checkoff in place in Australia and the producers themselves provide funds for research to be carried on either by private industry or, strangely enough, through giving money to government in order to do research.

The Chairman: That is a good sign, a good trend.

Dr. Migicovsky: A suggestion has now been brought forward to the minister, by the Palliser Wheat Growers Association originally, that there should be a checkoff on wheat for research. They intend to hold a plebiscite with respect to this in the West, and my concern now is to make certain that their strategy of allocation is correct. In other words, I would hate to see research come in from the private individual and therefore chase out the government research to go in another direction. That is not their purpose, which is to increase the amount of research on wheat. However, at the same time as we look at our programs and allocate funds, we look at whatever activities are being expended on a particular problem or a particular crop. We consider it on a Canada-wide basis and if we find through private subscriptions a great deal of research is being carried on with wheat, then maybe we should pay more attention to rye, vegetable crops and so on. Therefore, what will be very important in this connection, if they decide on this, is the "how" of allocating their funds. In my opinion, they will require a great deal of wisdom and I hope they obtain very good advice with respect to this.

The universities very likely will be the great recipients of these moneys, which will help the universities a great deal. However, I cannot see industry doing very much within the near future.

The Chairman: As I understand it, however, you now intend to launch, presumably, a food research program. We have a food industry.

Dr. Migicovsky: Now you are talking about the other end of it, the non-production. I have met with them on a number of occasions and they are prepared to take up contracts, but the food industry, as a rule, is very hesitant with respect to taking up research that will apply outside their particular company.

A recent development, which in my opinion was very positive, was that taken up by the Department of Industry, Trade and Commerce when, together with the food industry, they established the Protein, Oil, Starch Pilot Plant Corporation in Saskatoon, which is now being built. The board of directors consists of representatives from the Department of Industry, Trade and Commerce and, largely, industry, I representing the Department of Agriculture. The building will be completed in January. Its raison d'être is to house a research program to help the companies who are putting value added on to the raw product. I am sure we will have a fair degree of success. Some 20-odd companies are involved in this program, and they built this pilot plant facility, plus laboratoires, to carry out research for that industry. But what has to go hand in hand with this program are policies that will enable us not only to

produce the value added but to market it, and we might have to change some of our ideas with respect to marketing policies and the prices that have to be paid by the processor for the raw product in order to enable the processor to put value added and export that particular product.

Research, as members of the committee are aware, as has been said over and over again, is part of a whole picture. You cannot talk about research and industry, one isolated from the other; you have to think of it in terms of everything else that goes on in industry, such as the labour market, the market for the product, whether or not the product can be exported, the cost of materials, services, and so forth. It has to be looked at as a whole.

The Chairman: It seems to me that here again we are faced with a vicious circle. When we speak to you and others from government, we are told that industry is not really capable of or interested in doing research. On the other hand, when we speak to industry spokesmen, they say there is much too much research being done in government laboratories and that they are ready, willing and competent to carry out such research.

Where does the truth lie? Is there not some possibility of organizing a better dialogue between the two sectors of performance?

Dr. Migicovsky: Dealing with the producer end of it, the 350,000 farmers do not have the capability. Let's look at the food processing setup and food handling. In this regard we are not talking about an industry; we are talking about a group of individual companies. It is not an industry that does anything; it is a company that does it. What is to stop a Saskatchewan pool from setting up research laboratories to carry out research? We do have a policy now of contracting out, and there is a policy of putting in unsolicited proposals. Certainly, if we receive an unsolicited proposal, we look at it very, very seriously. Even if such a pool wanted to do work or research in which we are presently involved, we would look to the possibility of dropping out of it and handing it over.

If there were a number of companies that wanted to carry out research on plant breeding, we would have to satisfy ourselves that the farmers of Canada would be served by those companies. Our concern lies with the farmers of Canada, not the development of a plant breeding industry. Canada is a free country, and there is nothing to stop a man from starting a plant breeding company, and that individual would be in a position to receive research grants.

I do not know what we can do to stimulate industry. We are not in the business of stimulating industry. We are in the business of helping the agricultural industry produce its products.

The Chairman: Dealing with food processing, surely as a secondary objective you are also interested in the development of a competent and efficient Canadian industry to process food so that better markets can be developed.

Dr. Migicovsky: In any instance where a food processor has made a submission, I assure you it has received full attention. In most cases, research contracts have been issued. Our involvement in food processing is not very great. We are largely involved in the basic area. We are not particularly interested in operations. We may be concerned about the appearance of a substance that may be toxic, or something of that nature, or the chemical reaction that

might lead to something else. The food processors are more pragmatic, as one would expect.

I wish I had an answer as to why they did not develop more research facilities. The obvious answer that one receives from so many—and I can give it to you—is that the larger food companies are subsidiaries of very large companies in Western Europe and the United States, and those parent companies have extensive research facilities. This is a fact we cannot escape. We are a branch plant economy. Having heard and read the views of this committee, and you, Mr. Chairman, I take it your objective is to change our economy from a branch plant economy to a main plant economy. I do not think research is the means by which that can be accomplished. You will have to start some other way. A large company trying to be successful will use research, if it is going to help it; to impose research on such companies is not the way to do it. If they want to carry out such research, it is up to the government to help them do so, but it is not up to the government to impose such research on them. If companies see an advantage in research, surely they are clever enough to introduce such research.

The Chairman: How many unsolicited proposals have you received during the last year, and how many did you respond to affirmatively?

Dr. Hamilton: We receive about three a week. They come in through the Department of Supply and Services and are then forwarded on to the Department of the Environment, ourselves, and others. If our interest is maintained, we give advice on it and then attend a meeting with DSS on it.

The proposals that Agriculture Canada itself has picked up in the last year number about seven or eight. We have to have money to be able to pick them up. All of our money is out at our stations. Many of these unsolicited proposals are on the borderline of areas we should be covering.

The Chairman: I view that as an expression of interest from industry. I am still not very much impressed by the number of contracts that you have succeeded in allotting to industry.

Dr. Migicovsky: I think you should be, Mr. Chairman, by virtue of the fact that the industry we serve is so very different from any other industry. It is a large industry, but because of its makeup it does not have the means or capability of carrying out research. It is comprised of 350,000 farmers...

The Chairman: I understand that, but do you have any idea of the distribution of the performance of research by sectors in the United States and Australia? Obviously, Mr. Sahl did not give us any figures on that, although I am sure decided that they would rather not do the research, since the federal government and the universities are doing it.

What is our concern? Is our concern whether the companies are doing the research or whether the research is being done? What difference does it make whether the research is carried out by government, by universities, or by industry, if it is being done in sufficient quantity and the quality is high?

The Chairman: I see a difference in the sense that if the research is financed, or partly financed, and selected by the future potential user, there is more of a possibility or probability that that research will be used and will be

relevant. That is not to suggest that what you are doing is not relevant, but there would be greater probability that it would be relevant and used were it carried out by the potential user.

Dr. Migicovsky: That is a statement that is often made and, on the surface, it seems logical, but it does not always apply.

Let us take, for example, the program whereby we provide new varieties of cereals and other crops. Would those varieties be used more effectively if they were produced by a particular grain company, for example, that had a plant breeding facility and bred wheat for growth by our farmers, or whether they were produced by universities or in government laboratories? I do not think so. We have very effective plant breeding operations and that kind of technology transfer is as good as anywhere in the world. The variety gets out at the lowest cost to the primary producer. If a company wants to set up and produce different varieties of plants, the fact is that we help them. In fact, we give them the parent material, in terms of the genetic material, to work with, which they are usually incapable of producing because they do not have the expertise. But your question to me always is, "Why don't they do it?" You seem to feel that it is a responsibility of government—

The Chairman: No, no.

Dr. Migicovsky: —for them to do it. I think it is their responsibility and, if they want government help, to come to us; and never have they been turned away.

I agree there is the odd fellow who has come in with a very dreamy kind of program that we didn't buy and who therefore says, "Government just doesn't listen to us," and so on and so forth. You know, it just takes one rotten apple and we get damned from hell to breakfast because, they say, we only want to do it ourselves and we won't let it out. That is a lot of hot air. Give us a program that is reasonable, and a capability on the part of the man who submits it, and he will get the kind of help he requires. We will do everything we can to go through the process of getting our big budget, in using the fund that has been set up by DSS as an interim fund, and so on. We will do this, but they have not been coming in such great numbers.

The Chairman: Well, we will tell them to go and see you!

Senator Lang: Just on that same point. I sometimes like to go to examples. As a non-agronomist, I think McCain's Foods in New Brunswick would be a shining example of the private sector developing processed foods in a successful manner. It is not a branch plant; it is a main office.

Dr. Migicovsky: That is right.

Senator Lang: Do you know whether they do their own research?

Dr. Hamilton: No.

Dr. Migicovsky: Well, they do what we call the last part of the research, development work in their own plants, but the other research that is built up is taken from the overall research pool throughout the world.

Senator Lang: Do they receive assistance from the provincial or federal agricultural departments? I presume they must receive assistance from the provincial and/or agricultural departments.

Dr. Migicovsky: Anything that they would come in with we would certainly look at. I cannot certainly tell you whether McCain's themselves have received any, but certainly they would be in a position to receive it if they asked for it.

Dr. Hamilton: At the back door of McCain's, down the road, in Fredericton is one of the world's best research stations on potatoes. McCain's are there all the time. They know exactly what our scientists are doing on management, on growing, on scab...

Senator Lang: Is that a provincial research station?

Dr. Hamilton: No, it is federal, but as Dr. Migicovsky alluded to, in some places we have been able to orient the total job in agriculture, provincial and federal, to such an extent that at that very station the provincial department, 100 per cent—minister, deputy and everybody—are all in the same building with our research station, so that when you go there and McCain's is there they can walk from one office to the other and see federal and provincial workers; and McCain's watches us like a hawk.

Dr. Migicovsky: In other words, why do it and spend money when you can get it for free? And we have a history of having done it for free, and it is not easy to revert; it is very difficult because you are into a habit.

The Chairman: What about your patent policy?

Dr. Migicovsky: Well, we patent through CPDL.

The Chairman: But your policy is to try to get patents as much as possible?

Dr. Migicovsky: We do not put a great deal of emphasis on them.

The Chairman: Because otherwise it is in the public domain for farmers in Canada, is that correct?

Dr. Migicovsky: That is right.

The Chairman: But it is also in the public domain for our potential competitors outside the country?

Dr. Migicovsky: That is correct. In terms of the large work, that is right. There is very little of our work that lends itself to patents. For instance, the varieties. Some countries have what you would call breeder's rights where they can patent a variety almost. It is not quite a patent. We do not have breeder's rights legislation in Canada, and everything we put out is free for everyone to take.

The Chairman: We are generous?

Dr. Migicovsky: That is right.

Senator Cameron: Are there many private plant breeders developing work outside of government agencies?

Dr. Migicovsky: I do not know. Very few.

Dr. Hamilton: There are three being supported through NRC funds. Dr. Migicovsky mentioned Stewart Seeds. Now there are other groups in the country representing private plant breeders, and possibly in the United States.

The Chairman: Why would NRC support this kind of activity instead of Agriculture? Why would NRC support this?

Dr. Migicovsky: We do not have that kind of cost sharing program, and NRC does it on their—

The Chairman: Oh, it is done through their own program?

Dr. Migicovsky: Yes. I sat on that committee. It can come in from electronics; it can come in from any form of industry. They came in with a program and we said, "yes, that's fine" and they are developing new varieties and doing very well. In fact, they are doing so well that they thought it was a pretty profitable venture.

Senator Bell: Does the department consider a sort of negative research? I am thinking here with respect to dairy farmers and the research that has been done—I guess it is through the technology they are working with. We have all of the shortenings, and so on. Now margarine is hydrogenated in Canada, as far as I know, and the dairy industry has told us that "It's better with butter!" Now with some of this research that has been going on, it looks as if animal fats which are unhydrogenated are not nearly as bad as hydrogenated fats. That is the sort of negative research I mean, which might be very helpful to the dairy farmers if we get their products on to the market.

Dr. Migicovsky: Well, a lot of it has been done, as you are well aware. The debate has been raging for a number of years, at least 20, as to the kind of fats that are healthy and as to the kind of fats that are not healthy, and whether butter is harmful because of its cholesterol content and its high saturated fat content, and as to how much research should be done to disprove the myth, if you will, of what you are talking about. A great deal of research has been done throughout the world, some of it in Canada, and it still has so much emotional content that it has not been completely satisfactory to me. It is not conclusive to me, but we are talking about health, and we are getting to the point of saying frequently, "Well, there is a chance that it might be harmful, and it can't hurt you if you leave it alone; therefore cut it out." You arrive at that kind of thinking.

Senator Bell: But there is quite a bit of food technology that is producing questionable results, is that not correct?

Dr. Migicovsky: Yes.

Senator Bell: In fact, if you go back to the iron milling of flour instead of stone, and all the goodies, and that sort of thing.

Dr. Migicovsky: This is what some people have said, yes. It depends on what you want bread to do for you. You remember that during the war we were very concerned about the nutrition of our population and we produced a grey coloured bread which was produced by excessive milling of the flour so that more of the bran would appear in the flour, and people just would not eat it. They do not like it; they like white bread. If they are going to eat brown bread, they buy brown bread; and they just did not eat this off-coloured white bread. You would remember this.

Senator Cameron: Yes.

Dr. Migicovsky: And we pushed this very very hard. It was more nutritious and had a lot more of the thiamine and riboflavin present. Then the big argument came as to, "Well, all right, forget it. We will just make ordinary white bread. It is not as nutritious, but we will fortify it because now we have the pure substances. We can put a little bit of thiamine and a little bit of riboflavin and a little bit of

niaicin and iron and maybe a few other minerals." Is that the kind of nutrition that you should have? Well, nutritionists have different ideas about this. Bread does not necessarily have to be a complete food, any more than many of the other things that we eat. What you should have is a wide variety of foods which will give you perfect nutrition.

Senator Cameron: You used the word "excessive milling". Did you mean that?

Dr. Migicovsky: What I am trying to say is that—Well, I am not a miller. A high extraction flour; that is the term that is used.

Senator Cameron: Yes.

Dr. Migicovsky: You mill it to such an extent that more of the bran portion of the kernel comes into the flour and many of these vitamins, particularly thiamine and riboflavin, will be present in the bran.

Senator Yuzyk: Is cracked wheat the result of over-milling or under-milling?

Dr. Migicovsky: No, That is another process, a different process.

The Chairman: Well, I have the last question on the "make or buy" policy. You just said in your opening statement, I believe, that while you were all in favour of that policy, in principle, you had succeeded in getting MOSST to be quite flexible in applying the policy to different types of agencies in government.

I suppose that what you meant by this, looking at the figures that you have just given us, is that it practically means that the "make or buy" policy, as far as agriculture is concerned, has not been applied?

Dr. Migicovsky: It has been applied to the extent that it is desirable or possible.

The Chairman: But it has not been possible very often?

Dr. Migicovsky: Not to the extent that you would see in other departments. We do not have an automobile industry that can share this, or an electronics industry. I try to repeat and repeat and repeat that a large part of our industry is the food production industry represented by 350,000 farmers who do not have the capacity or expertise to do the necessary research. Historically government has done this. In recent years in some countries large integrated companies have undertaken research in this area. This has not been the case in Canada, but my feeling is that I would like to see them do this. And I am prepared to encourage them to the greatest extent possible by means of the make or buy program.

The Chairman: But in so far as the policy is concerned at the moment, are you the one to decide whether you will make or buy?

Dr. Migicovsky: No, the decision to make or buy has been taken.

The Chairman: But in specific cases?

Dr. Migicovsky: Yes, we are the people to decide whether we will buy or not.

The Chairman: Does not that put you in a kind of conflict of interest situation?

Dr. Migicovsky: I suppose it does, but I think we are honest, devoted public servants and we will carry out the policies of government.

The Chairman: Oh, I was not implying you are dishonest. Only politicians are dishonest. But is that not a situation where an external review would be needed?

Dr. Migicovsky: I would rather have an external review of my own program. I may be dishonest there, but I do not think I am. What I am trying to say is that given a program that we feel is worthwhile, and where there is a capability, there would be no hesitation on our part in going to Treasury Board for funds to support it.

The Chairman: But the "make or buy" policy was not really designed to be a reason or a justification to get more funds. It involves a transfer of funds but not necessarily additional funds.

Dr. Migicovsky: I told you about the difficulties involved in transfer. Eighty-five per cent of my budget goes for salaries, and if I am going to transfer any funds then I have to get rid of a certain percentage of my people. The only way I can do this is by attrition, and attrition is something you have no control over. It takes place by individuals and not by programs. In terms of programs I can decide to look for a company or somebody to carry them out. But attrition does not work in that way. It involves a plant pathologist here, or a physiologist there or an analytical chemist somewhere else. It is not a program, so I cannot transfer those because I have to maintain my program. But the fact remains that we try to look ahead to see what new programs we are looking at or what expansion we are looking at, and we put it into our budget. We name the program—it might be a swine nutrition program or an engineering program or a meats research program—and if Treasury Board will then support us and our budget as we have now for meats, for engineering and for reproductive physiology, then as soon as the money comes in we look for companies where we can place these projects. We set up committees made up of people from the outside—from universities and from industry—and they sit in judgment and look at all proposals and allocate the funds. We do not allocate the funds just by ourselves. We use advice from outside. But we have to get the money from Treasury Board to do it. There is no way that we have of using an A budget unless I suddenly chop off part of my own program. I am sure that if I were to do this my minister would get a mass of mail. He gets a lot of mail at the moment, but in those circumstances it would increase tenfold. For instance we have a man working in the wine industry in British Columbia. He is stationed at Summerland. Now he is due to retire next year and we already have letters coming in saying that we have to make sure that this man is replaced. We have not decided that we are going to continue with that program. It is a very small one. So perhaps we will be able to find a wine company who will put up some money there. But the wine industry itself is writing letters to the minister, to me, to the deputy minister, telling us that we have to replace this man. So you are up against this situation and it is one that is somewhat political too.

The Chairman: Then I come to the related problem of aging of researchers within government labs. With the budgetary constraints you have talked about and that you are working with at the moment, it seems to me that since you cannot fire people almost inevitably you have fewer and fewer positions available in the research field for young people. I may be wrong in this, but the result would

be, according to my reasoning, that the average age of your researchers is going up all the time. I realize there would be a limit, of course.

Dr. Migicovsky: Actually, our age problem is not as bad as it has been in other places. We thought it was much worse, but recently we took a survey.

The Chairman: Perhaps this man is wrong, this Mr. Sahl, but he says that during their discussions they learned that the people in the plant breeding program are in the general age group of 50 years and that they would be losing these valuable people through normal retirement before very long.

Dr. Migicovsky: In some disciplines the age distribution is far to the right. In others it is not as far. This does not concern me as long as universities are receiving enough support to turn out their graduate students. We would like to bring in more young people than we have at the moment and every time somebody retires or leaves then we bring in somebody who is young. We have even brought in people who have not yet received their Ph.D.'s and we have taken them on and then sent them back to school. We have a system whereby we can do this. So I am not too greatly concerned about this. But it becomes important when you talk about this aging situation that you provide to the universities sufficient resources to enable them to produce the highly trained personnel that we are going to need.

The Chairman: But if there are no jobs, why should young people go into that kind of training or that kind of research?

Dr. Migicovsky: I do not think I should worry about whether they are going to have a job or not. Let them worry about it like you worried about it and like I did. The fact remains that if I have to choose between an unemployed and uneducated individual and an unemployed Ph.D. I will choose the unemployed Ph.D. because he will find a way to make a living and to produce jobs for perhaps a dozen other people as well. I am not afraid of having too many highly trained people; this is the last thing in the world I would worry about. I am more concerned about having too many untrained people in this country because a highly trained person can do a job which an untrained person cannot do, but an untrained person cannot do a job that a trained person can do. Let the people worry about themselves a little bit, and let us not be too paternal.

The Chairman: I am sorry, but we have been told by the vice-president of the Science Council that we are facing a crisis in Canada because of the fact that there are fewer and fewer job opportunities in the field of research and that, as a consequence of this, fewer and fewer young university students are choosing a research career. He said that if this situation continued for, I think, the next three years we would have a real crisis in Canada.

Dr. Migicovsky: And what happens when that crisis occurs? We have had crises all the time. There is one every Monday morning as far as I am concerned. If that crisis occurs you will find that you do not have enough highly-trained people to fill the jobs you have, and then students will enter into it.

The Chairman: Then it may take seven or eight years.

Dr. Migicovsky: It might. I therefore say that research should receive more support right now in Canada than it

does. If that is the kind of incentive required for students, it will produce that incentive. Research is attractive in two ways. First there is the interest and then there is the money. Obviously if there are a lot of jobs paying high salaries you will find more people going into graduate schools. Now we have fewer. We will employ whatever comes out, hopefully, as you give us more resources to do research, both in-house and at universities. If you do not, the number entering the graduate schools will fall off to the point where there will be not an excess but a deficiency. In other words, it is a supply and demand operation, there is an up and a down. I do not know how you change this. I think what the vice-president of the Science Council was telling you, maybe in round-about words, was that you must increase the amount of research we do in Canada. We do not do it only to hire Ph.Ds. We do it for other purposes of research that are served. In other words, it produces more knowledge which will be utilized in the various industries, in the various fields of endeavour in Canada, and improve them, whether it be health or anything else.

The Chairman: My figures may be wrong, but I am still under the impression that when the NRC was before us they told us that the average age of their researchers in 1968 was about 35, or perhaps a little above that, and that now it is over 45. I should like to know if you would have that kind of information for the Research Branch of the Department of Agriculture. I am sure you have that information for 1968.

Dr. Migicovsky: I have it brought up to date. I have a curve of the age distribution throughout the Research Branch.

The Chairman: I would very much like to have that.

Dr. Migicovsky: It is not that skewed to the right. We have quite a few concentrated at the beginning, in the younger ranges. It falls off, and there is a fair number at the older ages, who are going to be retired within the next five or six years.

The Chairman: Could we have that kind of information?

Dr. Migicovsky: By all means. That curve has been prepared. We will have it sent to you.

The Chairman: I think it should be printed.

Senator Yuzyk: Dr. Migicovsky, I think this is a rather important problem that we are dealing with. Even Charles Lynch got excited about it and wrote an article entitled, "Out to Pasture." I thought at first this was about politicians, because he is always writing about politicians.

The Chairman: You thought it was about the Senate.

Senator Yuzyk: Yes, or about the Senate.

Senator Cameron: He thinks the senators are out to pasture.

Senator Yuzyk: He took up the case of a researcher by the name of Symko, who is on the Experimental Farm here in Ottawa and has been doing work on plant breeding; apparently he has not completed his work but he has been retired.

Dr. Migicovsky: Right.

Senator Yuzyk: Charles Lynch could get no kind of information on whether the program that this researcher

had been conducting for many years, and is about to produce other hybrids of grains, was to be continued. According to my reading, this researcher was crossing barley and wheat, and producing even more rows of barley, I think. I am not an agriculturalist, but I thought it was rather exciting. Why does not Agriculture Canada prepare for this? Why retire him at exactly 65 when he has not completed his program and there is nobody to take his place?

Dr. Migicovsky: He retires at 65 because the law of the land says he must retire at 65. Secondly I can assure you that he is not the kingpin of this program. That program will be continued, and will probably be done better after he leaves. With all respect to Charles Lynch, he did not 'phone me, he did not 'phone Dr. Hamilton, he did not 'phone Dr. Leroux, he did not 'phone anybody in the department.

Senator Yuzyk: But he got excited.

Dr. Migicovsky: Did you ask him whether he tried to find out? I cannot predict what Charles Lynch will write in his column. I do not agree with everything he writes, and probably you do not. He has to fill a column. Frankly, this was the biggest bunch of nonsense I have ever seen. Perhaps not the biggest, because I see a lot of nonsense. That is part of it.

Senator Yuzyk: He got interested in agriculture. That is one thing.

Dr. Migicovsky: But he suddenly lost interest.

Senator Yuzyk: What I am concerned about is that this person will no longer be at the Experimental Farm. He can still conduct his experiments in, say, the United States. Suppose the United States wanted to use him and the fruits of his research here. Can he go on to the United States?

Dr. Migicovsky: By all means. What happens with some of our researchers after they reach the age of 65 is that scientists are of such a breed, they are so interested, that they will continue to work without pay, and many of them do; they take their pension, we give them a little bit of space, we keep quiet about it; they have a spot in the laboratory and continue to work until they drop.

Senator Yuzyk: But this person could not do it. Because he was on the Experimental Farm he could only be employed by, say, private plant breeders or in the United States if they wanted to make use of his services.

Dr. Migicovsky: He cannot take all his genetic material with him; that belongs to us. I can assure you that we will have no trouble replacing Symko; none whatsoever. I do not care who it is, nobody is irreplaceable.

Senator Yuzyk: I am just giving you one case.

Dr. Migicovsky: Maybe a senator is not irreplaceable; I don't know.

Senator Yuzyk: After 75 we are replaceable.

Senator Bell: If you wanted to retain somebody over the retirement age, presumably you could hire him as an outside expert.

Dr. Migicovsky: There are ways that you could go about it by special means; you can retain him.

Senator Yuzyk: Contract work for instance.

Dr. Migicovsky: On special request for certain purposes they would listen to us and we would retain him.

Senator Bourget: With respect to the researchers in 1968, we were told that 39 per cent of the Ph.Ds were of foreign birth. Is that still the case?

Dr. Migicovsky: No.

Senator Bourget: It has changed considerably?

Dr. Migicovsky: Yes. Since that time we have not hired anybody other than citizens or landed immigrants. They may be of foreign birth. We do not look at where he is born. In fact, I could not care less where he is born right now, as long as he is a Canadian citizen or a landed immigrant. The important thing is that in the earlier years most of our Ph.Ds received their training outside of Canada, either in the United States or the United Kingdom or western Europe. In latter years a much larger proportion of our people have received their training in Canada.

Senator Yuzyk: Does this apply to veterinary science, too?

Dr. Migicovsky: It applies to veterinary science, too. It applies to all sciences. To a greater degree this is happening. One of the remaining factors is that many of our people receive their bachelor degrees in Canada and go to the United States or Europe for their post-graduate training, although not all. A larger proportion are receiving their degrees in Canada.

The Chairman: You say you do not make any difference between the Canadian-born...

Dr. Migicovsky: The Canadian citizens.

The Chairman: The Canadian citizens and the landed immigrants. I think there might be a difference, however, and I vaguely recall our discussion in 1968 which indicated that there were a number of researchers working in the Department of Agriculture who had come from Pakistan, India and other such countries, while in my opinion they would probably be more useful in their country of origin. There is no discrimination involved, as far as I am concerned, but there is certainly a difference there. Of course, as far as you are concerned, you apply the laws of Canada, and that is it.

Dr. Migicovsky: That is right.

The Chairman: However, it would be interesting, again, to have an idea of the change in the situation as compared to 1968.

Dr. Migicovsky: I do not think there has been a great deal of change. You realize that we must apply the laws of Canada, which we do. We also have the merit, which we apply. We do not look at where the applicant comes from so long as he is a Canadian citizen.

Senator Yuzyk: Or a landed immigrant.

Dr. Migicovsky: Yes, or a landed immigrant. There have not been that many and it seems to be exaggerated. What percentage do you think we have who have come from India or Pakistan? It would be a very small figure, less than 5, for example, much less. It was not only in connection with our department, but happened in all departments, including the Research Council and the universi-

ties. We took the cream of the crop from those countries and many of them came through the United States, receiving training in the American universities, emigrated to Canada, looked for a job and applied for it after becoming a landed immigrant and since they had the merit we hired them. I cannot say we bat 100, but we have done pretty well. We have one from India or Pakistan; I don't even know which country he is from, but it is one of the two, who is now Director of the Chemistry and Biology Research Institute, Dr. Saha. He got there purely by merit. He worked at the Saskatoon Research Station for a number of years and is one of our better directors. You say we would be better to have a Canadian-born-...

The Chairman: No, I do not say that. I say that in doing so, if we are doing it on a rather large scale—you say we are not—we are then rendering a very bad service to developing countries. It is related to the fact also that perhaps sufficient numbers of Canadians do not graduate from our universities interested in doing research in agriculture.

Dr. Migicovsky: No, that is not the case. There are not that many and I assure you that most of our people who graduate from Canadian universities as Canadian citizens, irrespective of where they were born, get first call. The problem really is in respect of those who come to Canada to obtain training for a period of two years as post-doctorate fellows, for example, and return. This is the post-doctorate fellowship program operated by the National Research Council. We used to get a number of those from countries in Africa, the Caribbean and so on. After two years they did not wish to return and received landed immigrant status. It is not for me to tell them to return, although you and I might agree that their own country needs them more than we. We must apply the law of the land. I am not in a position to tell them to return to Pakistan because that country needs them. They would soon tell me where to go.

Senator Cameron: Is it not true that some consideration was given to making it a condition of their research study in Canada that they would have to return to their own country?

Dr. Migicovsky: Yes, I think this was made a condition, but we can make the condition and the individual does not wish to comply with it.

Senator Cameron: Then he takes his chances.

Dr. Migicovsky: He does not get a job with us.

Senator Cameron: That is right.

Dr. Migicovsky: He stays in Canada and obtains employment in a university, industry or whatever the case may be. We have not hired these people who came to us as post-doctorate fellows for two years. I cannot think of any in recent years that we have hired. Some of them have come from countries where it would have been to their political detriment to return, and many conditions arise in relation to this, so we consider them differently.

Senator Cameron: But a number come here and realize that in going back to their homeland they face such limited resources compared to this country that they do not wish to return.

Senator Yuzyk: That became evident during the hearings of the parliamentary committee on immigration policy, at which quite a number of these appeared and

indicated, even those from India, very clearly that their country could not make use of their services, so why should they be forced to return?

Dr. Migicovsky: That is right.

Senator Yuzyk: Of course, we must understand some of these problems. However, in my opinion our policy in general has been good and we have not encouraged it as such.

Dr. Migicovsky: We also endeavour to be as tactful and kind as possible, as it is a very difficult area.

Senator Cameron: They realize after spending three, four or six years in Canada that there is this difference.

Dr. Migicovsky: Life is a lot better.

Senator Cameron: Yes; they would be returning to a deprived situation, really.

Senator Lang: With respect to the research program of the department, Dr. Hamilton mentioned that he could outline the present objectives and goals. I presume you could do that also with respect to the objectives and goals which existed in 1968. Between 1968 and the present there has been a considerable change in the world's food picture, I think you will agree. The world consumption is rising as the population explodes and we are faced with energy shortages and, most recently, potential climatic changes. In view of those facts, have the goals and objectives of the department changed since 1968 with respect to research work?

Dr. Hamilton: That is quite a big order. However, we should bear in mind that in 1968 we did not have goals and objectives formally structured and established as we have now. It was about 1969 or 1970 that all departments of government were asked to see if they could put into place a program of objectives and goals, programming, planning and budgeting and so on. Agriculture Canada through the research end decided it could give it a good try. We fought that since 1969 within our own organization. It has been tough, because people in research are afraid that someone will tell them how to do something that maybe they should be creating out of their own minds. However, we have gradually sold this whole concept, so that we are establishing objectives in line with our appreciation of the production problems and the restraints on production. We have fought the battles of focussing those objectives, by commodities largely, except for a very few which we cannot pin to commodities such as water and land resources and things of that nature.

The Chairman: And soil.

Dr. Hamilton: And soil. We have one of the very, very few examples of management by objectives being put into operation. In my opinion, the reflection of it today compared to 1968 is certainly clear. In 1968 we did not have such strong oil-seed objectives as we have today, whether it be for sunflowers or rapeseed. I do not believe that with respect to forage crops in 1968, we were thinking as we do today that there should be a doubling of production in the country, so we have increased that to quite an extent.

There was tremendous difficulty with respect to horticultural crops because, as you know, this country covers every climatic range possible and is in the northern end of the continent. There was such a variety of objectives throughout the country during the opening up and build-

ing of it. It was desired to do something in horticulture close at home. It was adapted to the different areas such as the apples in Nova Scotia and B.C. which caused quite a horticultural industry to build up. What have we been doing since 1968? Trying to lower the total professional man-years in horticulture. It is very difficult, but we have tried to lower them, so there is a reflection there. The horticultural research that was done in Ottawa has now been moved to Quebec and some to central Ontario. Many of these changes have taken place. We have realized that little efforts such as trying to do something with respect to dairying in the Gaspé would get us nowhere at all in the big picture. We negotiated with the Quebec government to pull out of that program. We have concentrated and consolidated much of our animal research in the country, more so than we have in the area of crops. We have consolidated animal research because through consolidation we can put better teams together. We put the whole Maritime animal research program into one place, all the poultry research in another place. In 1968, all those stations were carrying on these various activities. We have now consolidated everything.

Dealing with the Prairie region, again we have consolidated a lot of our animal work and poultry work. Research in the area of cereals has continued at several locations. All these things are planned 15 or 20 years ahead. We know what is coming. We know what it takes to put it together, and the job gets tougher and tougher all the time because more and more requirements enter into it.

In terms of land, we have to think of what we have to produce for our own population, as well as our export market, and what we may be called upon to provide in terms of aid. Certainly, we have to have a land inventory. We have to be able to classify our lands. We have to be able to provide recommendations on land use from a base of data from which we can interpolate, and have the types of soils adequately described so that productivity capabilities can be predicted with some reliability.

We have to have our lands classified in such a way that the classifications are meaningful whether you are talking about lands in British Columbia or lands in Prince Edward Island. We have put a great deal of effort into land resource development. Only yesterday, we awarded, through the Department of Supply and Services, \$200,000 worth of contracts to chosen performers who can help us get some of this data on land resource capability, and this covers the whole country. This is a continuing process and we are developing it as fast as we can.

The Chairman: We have been told in Ontario for several years now that we do not really have any recent study on land use. As you know, there is also a great deal of fuss about the best arable land in Ontario being withdrawn from agriculture. How much do we know about this area?

Dr. Migicovsky: There are a great many studies on land use. There is much disagreement as to what to do about all that is known, and it gets into a tremendous number of different vested interests, extending from those who hold the lands to political interests.

The Chairman: The Department of Energy, Mines and Resources claims it has a responsibility to carry out and maintain land inventories.

Dr. Migicovsky: There is an interdepartmental committee on land use. The lead department is the Department of the Environment. The Department of Energy, Mines and

Resources, the Department of Agriculture, and other departments, are represented on that committee. We play a very key role. We have a departmental committee on land use which has responsibility for this interdepartmental committee. Obviously, our great interest is in the retention of agricultural lands.

As you are aware, land is a provincial responsibility. The federal government, however, has an impact in terms of its policies and the techniques employed in any decision as to land use. For example, a 1,000-acre farm on the outskirts of Calgary, as development land, is worth \$2,000 or \$3,000 an acre, and as agricultural land, \$200 an acre. If you own that land, you would be very upset if it was zoned agricultural. So, in addition to the scientific problems as to the best use for a particular piece of land, you also get into the socio-political problems.

Senator Bell: What provinces, apart from British Columbia, have introduced a land use restriction in terms of agricultural needs? In British Columbia one cannot sell farmland without permission of the provincial government.

Dr. Migicovsky: As of this time, I do not believe any other province has instituted such a restriction.

Senator Cameron: I thought Nova Scotia started that.

Dr. Migicovsky: The Province of Nova Scotia has talked about instituting such a program. Prince Edward Island has such a program, but it relates only to foreign ownership.

Senator Yuzyk: The Province of Saskatchewan, also.

Dr. Migicovsky: Yes, but there is no real policy in place.

The Chairman: Perhaps Dr. Hamilton could continue.

Dr. Hamilton: I should like to give one or two more examples, because the program that we are developing, not only with our own resources, but knowing what the thinking is in the agricultural industry, in very close association with provincial governments and universities, is under great change all the time, but it cannot go around sharp corners. It goes in well thought out directions.

We need only look at what has happened in the beef industry since 1968 and what can still be done. The whole world is of the view that waste products, whether from pulp and paper mills, the agricultural industry, poplar trees in Saskatchewan, or whatever, warrant much more research with a view to utilizing these materials in the feeding regimes. We are going to approach this by contract. We feel that it has to be done, but we cannot simply take anything that comes along. We have to determine what has to be done to make a total program and then put it out to contract. The contractors are starting to appear on the scene. Some of them have got stronger during the last two or three years knowing that one day we are going to be awarding these contracts, so we have to prepare for this together.

Senator Yuzyk: Would this also apply to the use of garbage?

Dr. Hamilton: Yes, and to animal waste.

Dr. Migicovsky: There are some very serious health problems associated with animal waste, and these, too, would be involved.

Dr. Hamilton: We need only look at those things that have already turned our whole research program in beef into another kind of effort, such as the foreign cattle breeding evaluation program that this department has been called upon to carry out on several of the foreign breeds that have been brought into Canada. It takes 10, 15, 20 years to determine whether these foreign breeds, in crosses with our English breeds, are economically valuable. We have to determine their value in terms of gain. We have to determine the rate of gain in Manyberries, Alberta compared to the rate of gain in Brandon, Manitoba. The rate of gain in the two places is proving to be different for some of these animals. Who is going to obtain all these figures and sort them out? What about two or three-way crosses? We are involved with four or five breeds and we have three main stations consolidating the research, those being at Lethbridge and Lacombe, Alberta, and Brandon, Manitoba. This is our big push throughout Western Canada in foreign cattle breeding.

We stopped our investigation on a similar subject in the province of Quebec. We went far enough, and the Province of Quebec officials agreed with us that, in their setting, in connection with the great predominance of the dairy industry in Quebec, cross breeding for beef production need not be pursued further. We knew how far we had to take it, and we stopped.

Dealing with poultry breeding, a great deal of the research is carried out by industry, although we provide a lot of the background material on genetics, and so forth. In this area, too, we have consolidated our work. There are very few stations where we do poultry research now, but the answers are there for wherever they are needed and, therefore, we can consolidate. We put the whole Maritime research program into one consolidated effort so that each station takes responsibility for a certain area for the whole Atlantic region.

These are the kinds of things that have been done.

Dealing with fur-bearing animals, we decided the way in which to have a better program was to contract it out.

I could list all our main objectives and give you the goals. There are about 60 of them. We report on them each year and are constantly surveying them. If we come to a point when something should be changed or might come to an end, or a point at which the program should be instituted again for a further period of years, then a very good assessment is given. We also have out program review at the end of every year where we get together with the directors and their staffs and our group of specialists and account to ourselves, to our branch, to our department, as to the kind of job we are doing, and call the tune accordingly. We are very hard on ourselves in that regard.

The Chairman: Who is selecting the objectives and the goals, and how?

Dr. Hamilton: The objectives and the goals are selected by a lot of dialogue, a lot of argument, a lot of consultation. Really, I think the stations and the people working there have got to take the lead, but we have got to take a look at the overall.

Now let me, just before I finish, say this: In Saskatchewan and Alberta they have asked, because they are wondering about some of their goals or some of the directions in which they are going, what they should do about nitrogen research. Considering the energy problem, considering the price of nitrogen to agriculture, what should they do

about forage research, et cetera. What should the total program be at the new station at Lethbridge, Alberta? They have asked myself, their operations director and four of our specialists to come and spend the best part of a week at Saskatoon and Lethbridge to really look at the goals agreed upon for the next three to five years. Out of that is going to come a consensus, there is going to come a judgment, about the best path to follow. We will plan it together.

The Chairman: Is there any involvement by management at that level? By the deputy minister?

Dr. Hamilton: Not by our deputy minister.

Dr. Migicovsky: It goes as a recommendation to my office, and we sit down with an executive, of which Dr. Hamilton is a member, and we adopt it or change it. Then we have to go into budget, and we decide what we are going to go for.

The Chairman: But when do you consult your council?

Dr. Migicovsky: The Research Council?

The Chairman: The Canadian . . .

Dr. Migicovsky: The Canadian Research Council at this stage is now developed to the point where they are involved in this kind of operation. The Canadian Agricultural Research Council has just come into existence as of this last April. Their terms of reference do not necessarily include this overall recommendation to us.

We get recommendations from them and from all Canada committees which we take into consideration when we develop our goals, but there is no authoritative operation of any kind; it is all advisory. The Canadian Agricultural Research Council could on its own study rapeseed, for example. They will come up with a recommendation that there is no point in trying to make rapeseed meal a human food by virtue of the fact that it contains certain glucosinilates and therefore the chances of eliminating these glucosinilates are not there. Or they might advise: Yes, we think we should do more research to breed out the group of glucosinilates or process them out and work towards making rapeseed meal an equivalent of soyabean meal, an article of human diet. They could recommend that. We may take that recommendation into consideration and try then to move our resources into that area. Or alternative now is if we have a university or an industry—and the pilot plant corporation might provide this—where they are prepared to do certain research on rapeseed, we could give them a contract to handle a piece of that particular program. That is how our thinking is now, and where we can find an industry which will do a piece of it, this is the direction we will take. Where we can, we will go to a university, or we will do it ourselves insofar as we have the flexibility to move resources.

The Chairman: But the council will be more and more involved as an advisory capacity.

Dr. Migicovsky: In their advisory capacity, this is what we are hoping.

Dr. Hamilton: You know, I think personally, that our department could make greatest headway in contracting by doing it mainly with those who want to do it, and who are capable, and willing and able to do it, namely with the universities.

Dr. Migicovsky: You see, with the kind of work we do in research in agriculture, a good deal of the contract research that we give to the universities at the same time enables them to train the wholly qualified individual, the Ph.D. Not all of it, but a good part of it, and really they treat it much like a grant, except it is a contract that will run for a period of X years. The university now has to be very careful that it does not become a research arm of the federal government and that it retains its status as a university, because they are the only ones who can stand up and criticize the government without fear. I cannot, but they can.

The Chairman: But there is no great danger of that at the moment with the kind of money that they are receiving?

Dr. Migicovsky: Well, it is increasing, considering that from the initial \$400,000 they are now getting over \$2 million, over a period of a few years. We look at it in that way. We have made progress.

Dr. Hamilton: We cannot manage any faster. We have had to learn a lot about how to contract and manage, and some of our people, I think, are almost doing it too fast.

Dr. Migicovsky: Yes.

Dr. Hamilton: But to do good work.

Senator Bourget: Are the universities doing mostly basic research?

Dr. Migicovsky: In the faculties of agriculture, I do not classify it as such. There is some of it, because as agriculture it is obviously highly oriented and there are people who will say that as long as it is oriented it is not basic.

It depends on how you define your terms. Certainly, the research has to be relevant to agriculture, if it is done in a faculty of agriculture. So the moment you say it is relevant, it is not basic any more, because obviously some people think that basic research is simply what you call curiosity-based research. Well, that means that an individual scientist can get a very bright idea in the middle of the night and, whatever it is, he can go ahead and work on it. I am not against that. I think that should be done at universities, or a certain amount of it—as much as we can afford; but I do not think very much of it takes place at the faculties of agriculture. I am not against it.

Senator Bell: Could I ask another question on the contract situation, where Supply and Services enters into your picture, how long have they been with you, and are they efficient or a block?

Dr. Migicovsky: They are our business agents.

Senator Lang: A block?

Dr. Migicovsky: They are not blocks at all.

Senator Bell: Are they efficient?

Dr. Migicovsky: Oh yes. On occasions they will write a contract a little bit too generous and we will change it. It cannot go through unless we O.K. it. They act as our broker.

Senator Bell: And how long have you been working under that system?

Dr. Migicovsky: It is about three years now.

The Chairman: Since it was first initiated in 1973, I think?

Dr. Migicovsky: I think so.

Senator Bell: So that is long enough to see whether they are a help or a hindrance?

Dr. Migicovsky: I run into this almost always in my conversations with people from DSS. They will measure their success by the amount of money they are able to spend on contracts. I will measure my success by what you get for the money you spend on the contracts.

The Chairman: Yes.

Dr. Migicovsky: But that is a difference.

The Chairman: Once your goals and objectives have been determined, then I suppose that a certain number of projects are being examined. Who initiates the programs to reach the goals and objectives?

Dr. Hamilton: Within our setup, what we manage in Ottawa are the national objectives and the national goals, about 60 of them; scientists at stations do research related to one or more of the national goals, through pursuing a station goal, which fulfills part of a national goal. There may be one, two, three, or more station projects, on a station goal.

The projects are initiated by the workers themselves, by their director, and the report that comes in every year is management reporting to management—the director reports to us on how he has made out, and how the progress is related to the attainment of national goals. We think that is the only way to run it. You can never say that we are telling people how to run it.

The scientist can use his abilities to the fullest. The challenges are all there. We are only saying what we will support. We will keep track of what Canada should be attempting. With the small population we have in Canada and all of the corners that we have to cut in competition with others we think national planning of our research program is necessary. This has been our history in Canada, to manage pretty closely. We are quite different. We are different from Australia, and we are different from the United States, and I do not think we have to take a back seat to any one as to what we are doing to serve the industry.

The Chairman: And what kind of criteria or method do you use to evaluate the output of research?

Dr. Hamilton: Well, the output of research has to be evaluated from the standpoint of program. Our present deputy is always asking that question, and I think we are getting the performance indicators really tuned up more and more all the time. And the evaluation of research has to be just that. You cannot mix it up and say, "Measure what is happening out in the industry." We have to evaluate research data on new rapeseed varieties, not whether the farmer is getting out of them all the potential that is there. If we are trying to increase the rate of grain in a certain cross-breed—a three-way cross in animals—in a certain time period, then that figure is what is going to be measured. Now whether you measure a particular scientist as to whether he is an outstanding scientist, a fair scientist or a poor scientist, that can be measured through his output of scientific data, published reports, interaction

with the industry and a lot of different criteria of that kind.

The Chairman: But you feel that you can still improve your indicators or your measurements?

Dr. Hamilton: Yes.

Dr. Migicovsky: It is a very difficult area because everybody has different ideas. Are we going to look at the complete end-point of the research or some place in between? You can produce a very scholarly research paper that would be published in one of the journals, and certainly that is to your credit and it is one of the performance indicators. On the other hand you can produce a variety which in five years which will increase the yield by a factor of 20 per cent to the farmer. That is another performance indicator. Or if you are looking for a new method of control of an insect and somebody gets the idea of introducing the sterile male technique and after several years it is successful, that too is a performance indicator. The amount of fruit it will save in the case of a pest epidemic is another performance indicator but that is further down the line. You have to employ all of these. How much technology transfer has taken place? How much advice have you given to farmers that the farmer has benefited by? Talk to Senator Hays. I can assure you that a good deal of his success is due to the fact that he knew the people of Lethbridge and Lacombe and talked to them frequently. And he is a very successful farmer.

The Chairman: Even before he was Minister of Agriculture.

Dr. Migicovsky: Even before he was Minister of Agriculture.

Senator Bourget: We were told, when you appeared before the committee in 1968, that in the latter part of 1960 you had established what you called a national farm accounting and farm management system. What kind of success have you had? We were told at that time that this kind of system would be a very useful one to have.

Dr. Migicovsky: This has been established and is still in operation. It has been reduced somewhat because it is becoming more specialized. It is a service to the farmers. This is not in the area of research at all and it is operated by our production and marketing people. It is called Canfarm.

The Chairman: But you were hoping, so far as I can recall, that this could be used to provide better transfer of the results of your research to the farmers.

Dr. Migicovsky: That is correct.

The Chairman: Is it working?

Dr. Migicovsky: It is working well for those farmers who are prepared to take advantage of it. Very often this sort of thing is a two-way street. It takes time. But this has been consolidated and I think it is successful. But we have to wait a few years before we can say that it is a resounding success. I think we can show a number of farmers who have benefited by it but whether we have reached the number that we would like to reach, I am not sure.

Senator Bourget: Have the provinces played any role in that?

Dr. Migicovsky: Yes. It is one of the services rendered to them.

The Chairman: I am sure you are trying your best and this is a very difficult area—this whole area of the transfer of the results of research to the users—but I know that in the Fisheries Research Board, as a result of the study that was done, it was discovered that they had no proper information system for users. If we are spending a great deal of money on research and the results are read just by other scientists and not by the users, then it is not really very useful.

Dr. Migicovsky: Yes, and I made that point in my opening statement. The transfer of technology, of course, is shared by the provinces and by ourselves. It is essentially a responsibility of the province but nevertheless we assume a responsibility by means of our information department. We put out pamphlets and we go on radio and television. We do everything we can using the media to transfer the information to the farmers. In addition our stations always have a number of field days and farmers can come there and talk to the scientists and they hold small seminars and short courses and things of this nature. But the largest amount of technology transfer does take place and should take place via the provincial extension department because they have their agricultural representatives who are supposed to roam the country and talk to the farmers either individually or at meetings. They must be in touch with the research operations going on at universities and at our places, and in many of our places we have such people living with us and they have offices in our own establishments. For example the provincial department of agriculture built the building in Fredericton and the same thing is happening in Charlottetown. Our new building at Kentville is being built in the same way and the same thing applies at Harrow and Lethbridge. In so far as possible we try to bring in the extension people with us so that they can carry the message and in addition we use our own media to transfer the technology. I think we have been reasonably successful, and I think one of the measures is this; how long does it take from the time we register a variety to the time it is being grown, and this is usually two years.

The Chairman: Has the time lapse been declining over the years?

Dr. Migicovsky: Yes, it has, over the years. Often we find that the farmers want the thing before we are really ready to give it to them and sometimes they get it at that stage and we are a little bit leery about it because we have not quite completed it. Fredrick wheat is a good example. By the time we registered it almost all the wheat grown in Ontario was Fredrick wheat.

Dr. Hamilton: About three years after it was put out it was on 85 per cent of the acreage. Cereal grains, whenever we put one out, the farmers are convinced that they must have it because it is good. They almost beat down our doors to get it. But with forages we are worried. Grass is still grass to too many people. We can put out better forage varieties but people are terribly slow to take to it. People just cannot see it in terms of return of pasture. People have the idea that grass is grass and that is all there is to it. A lot of the extension publications which come out every year arise because we have sat with the provincial people and contributed data and helped write the publication. We have had a long history of working together and doing these things.

Senator Yuzyk: It may be that I am whipping a dead horse, but Information Canada is not almost phased out

completely. Using agricultural terminology, what appeared to be a good crop now turns out to be a weed. What use did Agriculture Canada make of Information Canada when it did exist in its meteoric career?

Dr. Migicovsky: Well, we probably did not do justice to it, and I do not know where the fault lies and so I am not going to point the finger at anybody. We had an information department that was operating, and we have small set-ups, information set-ups, throughout where we had direct access to our clients. We did not think that Information Canada had that kind of access in the rural community. Obviously anything that we published to be distributed was given to Information Canada for distribution. But it is rather like putting it in a library; it is there and if people want to use it they can come there and use it.

The Chairman: Most of the other departments did the same thing.

Senator Yuzyk: So you are not sobbing for Information Canada then?

Dr. Migicovsky: I am to a degree, because I think there is a place for Information Canada. I think there is a strong place for it, but that is another subject.

The Chairman: For the next government.

Senator Lang: I have become very toxicity conscious during the last three days. Firstly, there was an article in the *Globe and Mail* about that syndrome that you referred to in New Brunswick.

Dr. Migicovsky: The Rye's syndrome.

Senator Lang: I learnt yesterday that NRC had given a very large grant to a hospital in Rochester, a United States hospital, concerning metal toxicity.

Dr. Migicovsky: They are worried about mercury.

Senator Lang: Then there is the blue tongue in B.C.

Dr. Migicovsky: Also, there are these abnormal births in southern Ontario.

Senator Lang: At Windsor. Are there any other acute problems such as that in New Brunswick, if there is any truth in the article? Are there any other situations comparable to the New Brunswick one extant in Canada today?

Dr. Migicovsky: Not to my knowledge. There have been similar outbreaks of the type they call Rye's syndrome—it is a syndrome, not a disease—occurring in other parts of the world with different factors involved other than what Dr. Crocker observed on his mice, if you read that article. It is a subject that concerns me greatly. I am afraid that we are going to run into new things. The reason why we cannot explain them is simply because we are ignorant. We are in the same position that civilization was in several hundreds of years ago when they had epidemics such as the bubonic plague and thought it was God knows what.

Senator Lang: An act of God.

Dr. Migicovsky: You can call it an act of God, if you will, but my kind of god does not do this. But we do it, and we do it without being aware of it. What I think we are going to need, and hopefully will come to, is to go to government and sell them on the idea that there is a great need for a capability to get all the basic information that is required so that we can understand these events when they occur.

Without understanding we cannot do anything about them. I cannot guarantee that we will be able to do anything about them if we do understand them, but at least let us start to try to understand them. I think we are dealing with a phenomenon of which we know nothing. I am talking about the possibility of several events occurring at the same time, and we do not know enough about each one event. We are spraying, and although we test all the sprays we perhaps do not know the methodology to carry forward to see whether this is at the bottom of, say, the Rye's syndrome. We really do not know. The experiments that Crocker carried out were anything but conclusive. They were on mice. We did not know what the doses were, and we found similar diseases occurring with things that had nothing to do with the spruce budworm spray, or with the particular virus that Crocker tested.

This is a very complex subject. I do not think we have the expertise in Canada. There is not enough expertise throughout the world for that matter, and not enough work is being done. I have grave concerns about the manner in which we are living today, that we are going to precipitate events which could be very tragic. I think we should start investigating now, getting money into the universities, at least to train people to be capable of studying this particular subject. It has to be on an integrated basis. It is not a single discipline; it is not just chemistry.

The Chairman: Not even on a national basis.

Dr. Migicovsky: I think at the start we should put sufficient money into two universities. I am afraid they might force us to spread it thinly. I hope they do not. At most there should be two places, with sufficient funds to build up an integrated program at those universities in order to utilize the various disciplines required. It will have to be associated with the medical schools; it will need analytical chemistry, biochemistry, pathology, epidemiology, and agriculturalists and environmentalists to work with them, to say nothing of computer programs.

Senator Lang: And NRC.

Dr. Migicovsky: It takes in everything. We are now going to talk about it, but I agree with you that it is a subject of great concern.

The Chairman: Are there any other questions? . . . I just want to put a final question. I want to quote you. You said, I think some time last year, that the Prairie soil had about one-third less nitrogen than it had 20 years ago. Does this worry you, and what is being done about it?

Dr. Migicovsky: Obviously, so long as we have nitrogen fertilizer we can make it up. What worries me is that the price of nitrogen fertilizer might go up. Efforts are now being made; there are expanding programs at NRC and within our own operation, and in encouraging universities to go into this general subject of nitrogen fixation. As you know, a legume fixes gaseous nitrogen by virtue of an enzyme system. We think we can do something along this line and be able to save some of our nitrogen fertilizers by introducing into our food crops a capability of utilizing nitrogen from the atmosphere that is being fixed and introduced into the soil.

The Chairman: There is nothing left for me but to say thank you very much indeed. We have had a good session. As you can see, we would have had a lot of other questions, I am sure.

Dr. Migicovsky: It has been my pleasure.

The Chairman: We have to proceed with other agencies this afternoon and during the remainder of the week. I want, on behalf of my colleagues, to tell you that we are

very grateful for your appearing before us at this unusual time of the year. Thank you very much.

Dr. Migicovsky: Thank you, Mr. Chairman.

The committee adjourned.

APPENDIX "27"

Minister
Agriculture Canada

February 10, 1976

Senator Maurice Lamontagne
The Senate
OTTAWA, Ontario

Dear Mr. Lamontagne:

Science Policy and Futures Studies Activities

I note in your letters of September 23, October 16, and November 17, 1975 that a Senate Special Committee on Science Policy will consider and report on Canadian government and other expenditures on scientific activities, and matters related thereto.

The Research Branch of Agriculture Canada is, as you know, the largest research organization in Canada. It has been actively engaged since 1969 in organizing its total program according to Management by Objectives planning. It has been very successful in bringing about an MBO orientation to its total program, involving some 47 research establishments.

The Research Branch is now assessing present policies and preparing recommendations on its future role, as one of the strong forces in Canadian agriculture. We have not yet completed this review.

I am forwarding the following documents:

1. A document recently prepared on the current program of the Research Branch. Five copies are attached. You will note concise statements on research objectives, by commodities and special programs, along with a statement of the goals under each objective and the professional man-years devoted to each. In the document you will find statements describing our methods of planning, managing, evaluating, and updating programs. There are also statements on important, new or

expanded lines of research endeavour which are, more or less, still in an advanced stage of consideration, namely:

Projections for

- a food program
 - a water program
 - an energy program
 - an international activities program.
2. Nine case histories of significant, completed research projects as requested in Volume I of A Science Policy for Canada, page 297.
 3. A description of our Operating Grants Program with universities, our Contracting Program with industry and universities, and Agriculture Canada's Extramural Research Program with universities.
 4. A Research Branch Report by programs 1974.
 5. A Research Branch Report by stations 1974.

I trust these documents are pertinent to your study and provide the most helpful way of gaining insight into Agriculture Canada's research thrust. Should you require further information or additional copies, please advise.

It is my understanding that information pertaining to personnel matters, and to budgets and expenditure patterns, have been furnished by the Ministry of State for Science and Technology. Again, should you require further information, please advise.

It is also my understanding that comments on recommendations made in Volumes II and III of Science Policy for Canada have reached you through MOSST. Similarly, responses to some questions in your October 16, 1975 letter have been made by Treasury Board.

We judge that these documents will be of direct help to you in the study described in your letters.

Yours sincerely,

Eugene Whelan

APPENDIX "28"

December 9, 1975

RESEARCH BRANCH PROGRAM

CONTENTS

	page
Concepts.....	1
Classification of Research.....	3
Program Review.....	4
Performance Indicators.....	5
Branch Goals.....	6
Branch Objectives.....	7
Professional man-years allotted to each Branch objective.....	8
Professional man-years allotted to each Branch Goal.....	9
Description of objective on:	
Forage Crops.....	12
Oilseed Crops.....	14
Horticultural Crops.....	16
Cereal Crops.....	19
Field Crops.....	22
Beef Cattle.....	24
Dairy Cattle.....	27
Swine.....	29
Poultry.....	31
Sheep.....	32
Other animals and bees.....	34
Biosystematics.....	36
Land and water resources.....	37
Environmental Quality.....	39
Proposed program on energy.....	41
Proposed program on food technology.....	43
Proposed water resource program.....	45
Statement on international activities.....	46
Relationship of Branch Objectives and Goals to Departmental Objectives and Government Priorities.....	48
Figure 1.....	50
Figure 2.....	51
Table 1 from Future Agriculture Research Mission (1974).....	52
Organization Chart.....	53

THE RESEARCH BRANCH PROGRAM

Concepts

The Research Branch is organized to solve current and anticipated agricultural problems in the many soil and climatic zones of Canada. Its programs are designed to determine optimum conditions of soil and climate for specific crop and animal production; to create new and

improved varieties of crops and animals; to reduce losses caused by diseases, weeds, and insects; to improve crop management techniques and animal husbandry through biological and engineering studies; and to develop new and improved methods for the preparation and preservation of food. This program of research is carried at 47 stations and experimental farms across the country.

As a guiding philosophy for its mission in research the Branch operates within the following broad aims:

—To ensure an efficient, stable and profitable agricultural industry in Canada.

—To ensure the adequate surveying, conservation, judicious use, and proper management of natural resources essential to agriculture.

—To develop new knowledge and improved technology that will ensure the efficient production of an adequate supply of food and agricultural products of the desired form and quality.

—To conduct research and provide support for other branches, departments and agencies in activities of national concern.

—To encourage and assist research programs within developing countries and the training of their technologists.

Since 1969-70 the research program has been organized by objectives and goals under the philosophy of management by objectives. The Research Branch readily adopted this philosophy of managing by results because it ensures forward planning and budgeting of resources. It also ensures better communication and makes possible a fuller appreciation of priorities. At the same time it stresses the need for the involvement of scientists in goal-setting for greater achievement. Thus the primary role of the Branch is stressed in terms of priorities within its mission, and in terms of high standards for the research.

The objectives and goals of the Research Branch support the objectives of the Canada Department of Agriculture, which, in turn, support the missions of the government (see figure 1). For each Branch objective there is a program, i.e., a plan of action for research. This program is subdivided, in most cases, into programs leading to the attainment of Branch goals. The Branch goals are based upon establishment goals. Each establishment goal has a program of research consisting of one or more projects initiated by scientists. As might be expected, projects often contribute to more than one establishment goal. Cooperative research projects and programs involving several stations are also common.

The Department of Agriculture is organized into five operating branches: (1) Economics, (2) Food Systems, (3) Health of Animals, (4) Production and Marketing, and (5) Research. The Research Branch cooperates directly and indirectly with the other branches for the attainment of common Departmental objectives. The Research Branch provides technical advice for some branches and receives much in return. Staff members from Economics and Health

of Animals are associated directly at some Research Branch establishments.

Classification of Research

There are many ways to classify or record research and thus many ways in which objectives may be written. In the Research Branch, commodities of crops and animals were chosen as the basis for formulating objectives because they provide real targets for assessment and accountability and some realism in a cost-benefit analysis. They also show that the research of the Branch is mission-oriented. Other objectives were written to cover resource programs such as biosystematics, land and water resources, and environmental quality.

A program of research leading to the attainment of a particular objective is, in most cases, a combination of research by scientists trained in specific disciplines. Problem solving then, often becomes a matter of the multi-disciplinary approach. A block diagram, which illustrates the extent of research in cereal crops, is given in (figure 2).

When there are problems common to several crop kinds and specific within one discipline it is possible to formulate some programs on a discipline basis. The research components can be displayed by a matrix or grid (see table 1 from Future Agriculture Research Mission document, 1974 data). Detailed inventories are prepared and issued annually displaying research goals (and thus programs) by disciplines and secondly by stations. Another sort by the computer lists the establishment goals. Finally all individual projects are coded by objectives and goals and are catalogued for cross references.

Program Review

Implicit in all good management procedures is a periodic review of progress. Since 1971 the Branch has conducted an annual review of all research programs. This review begins at the establishments and ends in an assessment of the program at headquarters. Reports are prepared for submission to the Department and as a means of communication within the Branch.

The Program Review report issued by the director of each establishment is a report of stewardship for the programs under his responsibility. It deals with both ongoing programs and those for which a termination or "target date" has been reached. It predicts adjustments in manpower and resources and is the chief means for projecting future requirements in professional manpower. New proposals for research or major changes of programs are documented on special forms.

The process of program review at headquarters is the responsibility of a staff group of research coordinators. They are appointed on either a commodity or disciplinary basis and serve as advisors to line management of the Branch. They include about 15 scientists, and their specialties are such that they can provide a reasonable degree of detailed knowledge and expertise in their area of responsibility. All have been working scientists who have established national and international reputations in scientific research. Since directors of individual research stations and line managers have also been promoted from the ranks of working scientists, the combined backgrounds of these individuals provide a sound basis for research policy decisions.

The Program Review culminates in a research report by programs (copy available).

Performance Indicators

Projects

Basic to accountability of the Branch programs is the research project. For it, performance indicators can be written which are quite specific and measurable. They are in fact the stated goals of the projects. However, it should be stressed that success in research is uncertain and frequently negative results are attained which have value. A proper balance in emphasis must be maintained between quality of research and success in goal achievement. Performance indicators for projects normally are discipline oriented. Two examples follow:

1. By 19—to incorporate genes for low erucic acid into rapeseed varieties with acceptable agronomic characteristics.
2. By 19—to have determined the nature of the chemical bonding mechanism protecting polar pesticides from degradation in organic soils.

Accountability on projects is direct and personal between the scientist and his section leader or director. It is done annually or at periodic reviews of the project. Research Coordinators in contact with scientists by visits to stations assess progress or failure as well. Annual project reports are included as details of Program Review and are compiled at headquarters as part of a system for scientific information.

Establishment Goals

The program leading towards an establishment goal is broader than a project and is normally an aggregate of several projects. The goal may be the solution of a regional agricultural problem on a commodity basis, or the solving of a national technology research problem in some functional area. For most comprehensive establishment goals several scientists are involved but frequently only part man years of each. Performance indicators for establishment goals are expressed in terms of the potential impact on the problem of several research results from specific projects. These indicators are part of the statement of the establishment goal. Two examples follow:

1. By 19—to develop corn hybrids and the necessary management practices to produce 100 bushels of grain per acre on irrigated land in a 2100 corn heat unit season.
2. By 19—to develop improved methods of irrigation including water delivery and drainage systems to increase water use efficiency, help control soil salinization and contribute to improved irrigated crop productions.

Accountability is judged in annual reviews at the establishments. The assessment of progress on the establishment goals forms the key statement of the director in his program review. He supports his stand with summary statements from projects which have been active within that particular establishment program. This summary is a mixture of scientific evidence and judgement about potential impact on the practical problem.

Research Coordinators are indirectly involved in assessment of establishment goals through visits to stations when programs are examined. For cooperative programs common to several stations a review, external to the establishment, operates. Work-planning meetings along discipline lines examine progress for some establishment goals that are resource-oriented.

Branch Goals

The number of scientists and establishments cooperating on a Branch goal is variable depending upon the geographic adaptability of the commodity, the complexity of the production or protection problems under study, or the nature of the resource problem being pursued, e.g., land evaluation is a national problem from coast to coast. Performance indicators for Branch goals are less precise than for establishment goals or for projects. Nevertheless, they are stated in as concrete a way as possible in the Branch goal in order to give the Branch some measure of accountability. All Branch goals are listed in this report.

Accountability of a Branch goal is judged at the annual Program Review and is a prime responsibility of the Research Coordinators. The procedure is a consultative one to some extent because through station visits and other contacts Coordinators are familiar with the progress of the research. The formal review of the written reports and the compilation of these into a summary statement of progress, sharpens the process. Judgement is also exercised by the Coordinators. The result of this review is an annual report—Research Branch Report by Programs.

Branch Objectives

Branch objectives set broad areas of concern for the mission of research at headquarters.

At headquarters a measure of success or failure on the attainment of the Branch objectives is made annually at Program Review by Coordinators. To a considerable extent it is a collective assessment of managerial judgements. It forms the substance of a report with recommendations made by Coordinators to the Executive. It is the guiding principle for advice to the Executive on expansion or contraction of support for specific objectives, and for program forecasting.

Summary

Departmental Objective 6:—Maximizing the utilization of Canada's agricultural resources

<u>Research Branch Objectives</u>	<u>Man Years</u>
Forage Crops	91.3
Oilseed Crops	47.4
Horticultural Crops	198.1
Cereal Crops	169.3
Field Crops	35.8
Beef Cattle	72.3
Dairy Cattle	25.8
Swine	12.9
Poultry	18.2
Sheep	5.6
Other animals and bees	3.5
Biosystematics	55.6
Land and water resources	45.2
Environmental quality	23.0
Service	6.0
	810.0

A further breakdown by objectives, goals and professional man-years follows in tabular form, and then, in descriptive form, including a statement on "purpose of program" for each Branch objective. There are also descriptions of four projected programs on energy, food, water, and international activities.

RESEARCH BRANCH GOALS

<u>Objective</u>	<u>Goal</u>	<u>Subject</u>	<u>Man Years</u>
Forage Crops	1	Legumes	40.4
	2	Grasses	29.7
	3	Biological Control	3.2
	4	Winter Hardiness	9.5
	5	Irrigation, Drainage and Desalinization	5.2
	6	Plant Nutrients	<u>3.3</u>
			91.3
Oilseed Crops	1	Rapeseed and Mustard	22.0
	2	Sunflower	5.2
	3	Soybeans	5.1
	4	Flax	4.1
	5	Pest Control Programs	<u>12.0</u>
			47.4
Horticultural Crops	1	Tree Fruits	56.6
	2	Berries	19.0
	3	Vegetables	44.9
	4	Potatoes	33.6
	5	Ornamentals	11.5
	6	Insecticides and Fungicides	18.0
	7	Viruses and Mycoplasmas	10.5
	8	Nematodes	<u>4.0</u>
			198.1
Cereal Crops	1	Wheat	65.9
	2	Barley	30.4
	3	Oats	19.3
	4	Corn	18.6
	5	Rye	1.2
	6	Plant Diseases	4.4
	7	Soil-Borne Pathogens	6.0
	8	Herbicides	10.0
	9	Meteorological and Climatic Parameters	8.8
	10	Problem Soils	<u>4.7</u>
			169.3
Field Crops	1	Tobacco	16.0
	2	Field Peas	3.2
	3	Buckwheat	2.0

	4	Sugar Beets	1.4	Other	Animals		
	5	New Crops	3.0	and Bees		1	Honey Bees
	6	Beans	4.3			2	Fur Bearers
	7	Weed Ecology	<u>5.9</u>				<u>3.5</u>
			35.8	Biosystematics		1	Vascular Plants
						2	Insects
						3	Fungi
Beef Cattle	1	Breeding	8.7				<u>10.0</u>
	2	Cow-Calf Systems	36.9				55.6
	3	Feedlot	8.7	Land and Water		1	Soil Resources
	4	Beef Products	4.5	Resources		2	Classification of Soils
	5	Animal Reproduction	8.3			3	Land Evaluation
	6	Pesticide Residues	<u>2.4</u>				<u>3.5</u>
			69.5				45.2
Dairy Cattle	1	Dairy Cattle Breeds	4.7	Environmental		1	Animal and Crop
	2	Yield of Milk	13.7	Quality			Wastes
	3	Milk Products	<u>7.4</u>			2	Pesticide Management
			25.8			3	Plant Nutrients
						4	Non-agricultural
Swine	1	Swine Production	<u>12.9</u>				Pollutants
			12.9	Service			<u>23.0</u>
							<u>6.0</u>
Poultry	1	Eggs	11.2				<u>6.0</u>
	2	Poultry Meat	<u>7.0</u>				810.0
			18.2				
Sheep	1	Lamb Production	<u>5.6</u>				
			5.6				



Government
Publications

FIRST SESSION—THIRTIETH PARLIAMENT
1974-76

THE SENATE OF CANADA
PROCEEDINGS OF THE
SPECIAL COMMITTEE OF THE SENATE ON
SCIENCE POLICY

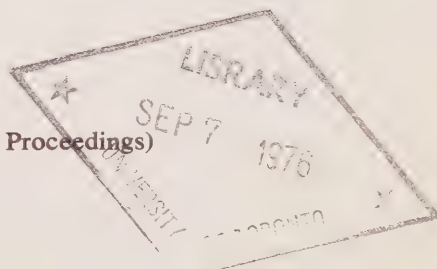
The Honourable MAURICE LAMONTAGNE, P.C., *Chairman*

Issue No. 16

TUESDAY, AUGUST 10, 1976

Sixteen Proceedings on
The Study of Canadian Government and
other expenditures on scientific activities
and matters related thereto.

(Witnesses and appendices: See Minutes of Proceedings)



THE SPECIAL COMMITTEE OF THE
SENATE ON SCIENCE POLICY

The Honourable Maurice Lamontagne, P.C., *Chairman*

The Honourable Donald Cameron, *Deputy Chairman*

and

The Honourable Senators:

Asselin	Hastings
Bélisle	Hicks
Bell	Lang
Blois	Manning
Bonnell	Neiman
Bourget	Riel
Buckwold	Robichaud
Carter	Rowe
Giguère	Stanbury
Godfrey	Thompson
Goldenberg	van Roggen
Grosart	Yuzyk
Haig	

27 Members

(Quorum 5)

Order of Reference

Extract from the First Report of the Special Committee of the Senate on Science Policy, presented on July 10, 1975 and printed as an Appendix to the Minutes of the Proceedings of the Senate of that day, and adopted by the Senate on July 24, 1975:

"The Committee, therefore, recommends that it be authorized to consider and report on Canadian government and other expenditures on scientific activities and matters related thereto;

That the Committee have power to engage the services of such counsel and clerical personnel as may be necessary for the purpose of the inquiry;

That the Committee have power to send for persons, papers and records, to sit during adjournments of the Senate and to report from time to time; and

That the Committee be authorized to print such papers and evidence from day to day as may be ordered by the Committee."

Robert Fortier,
Clerk of the Senate.

Minutes of Proceedings

Tuesday, August 10, 1976.
(26)

Pursuant to adjournment and notice the Special Committee of the Senate on Science Policy met this day at 2:30 p.m., the Chairman, the Honourable Senator Lamontagne, presiding.

Present: The Honourable Senators Bell, Bourget, Buckwold, Cameron, Lamontagne, Lang, Stanbury and Yuzyk.
(8)

In attendance: Mr. Philip J. Pocock, Director of Research, and Jacques Ostiguy, Chief of Administration.

The Committee resumed consideration of its Order of Reference dated July 24, 1976 relating to the study of Canadian Government and other expenditures on scientific activities and matters related thereto.

The following witnesses from the *Department of the Environment* were heard:

Dr. E. F. Roots,
Science Adviser,
Planning and Finance Service;

Dr. J. R. Weir, Chairman,
Fisheries Research Board;

Mr. J. P. Bruce,
Acting Assistant Deputy Minister,
Environmental Management Service;

Dr. M. C. B. Hotz, Director,
Integrated Programs Branch,
Planning and Finance Service;

Mr. W. K. Sharpe,
Director,
Water Pollution Programs Branch,
Water Pollution Control Directorate,
Environmental Protection Service;

Mr. F. G. Hurtubise,
Director General,
Environmental Conservation Directorate,
Environmental Protection Service;

Dr. A. E. Collin,
Assistant Deputy Minister,
Ocean and Aquatic Sciences;

Dr. A. May,
Acting Director General,
Resource Services Directorate,
Fisheries Management;

Dr. R. J. Bouchier,
Director-General,
Canadian Forestry Service.

On Motion by the Honourable Senator Yuzyk, it was *Agreed* that the preamble of Volume I of the brief presented to the Committee by The Department of the Environment be printed as an appendix to this day's Minutes of Proceedings and Evidence. (*See Appendix "29"*)

Dr. Roots and Dr. Weir both made opening statements. The witnesses then answered questions put to them by Members of the Committee.

During the question period, Dr. Roots quoted figures from a document entitled "Comparison of DOE Science Expenditures". On motion of the Honourable Senator Yuzyk it was agreed to print this document as an appendix to this day's Minutes of Proceedings and Evidence. (*See Appendix "30"*)

At 5:30 p.m. the Committee adjourned until 9:30 a.m., Wednesday, August 11, 1976.

ATTEST:

Patrick Savoie,
Clerk of the Committee.

The Special Committee of the Senate on Science Policy

Evidence

Ottawa, Tuesday, August 10, 1976

The Special Committee of the Senate on Science Policy met this day at 2.30 p.m. to consider Canadian government and other expenditures on scientific activities and matters relating thereto.

Senator Maurice Lamontagne (Chairman) in the Chair.

The Chairman: This afternoon we have, as you can see, an impressive delegation from Environment Canada. I would like to introduce Dr. E. F. Roots, who is the Science Adviser, to the department; Dr. J. R. Weir, who is now the Chairman of the Fisheries Research Board. We will also recognize him, I am sure, as a former member of the Science Secretariat which was the embryo of the now Ministry of Science and Technology. I understand that Dr. Roots will introduce the remainder of the delegation.

Dr. E. F. Roots, Science Adviser, Department of the Environment: Thank you, Mr. Chairman. I bring the apologies of our Acting Minister and our Deputy Minister that they were not able to be present this afternoon. However, what we lack in quality and seniority, I think we make up in quantity along the wall here, sir.

The Chairman: Perhaps also in quality.

Dr. Roots: I would like to introduce the gentlemen who are here today, to whom you may wish to direct questions. Seated beside the wall, starting from nearest this end, is Dr. Collin, Assistant Deputy Minister, Ocean and Aquatic Sciences; Mr. J. P. Bruce, who is Acting Assistant Deputy Minister, Environmental Services Management, and who is Director General our Inland Waters Directorate; Dr. D. E. L. Maasland, who is Director General, Policy and Program Development, Environmental Management Service; Dr. W. L. Godson, Director General Atmospheric Research Directorate in the Atmospheric Environment Service and one to whom you may wish to address meteorological and weather questions; Dr. R. J. Bouchier, Director General, Canadian Forestry Directorate; Mr. Hurtubise, Director General, Environmental Conservation Directorate; Environmental Protection Service; Dr. Arthur W. May, Acting Director General, Resources Services Directorate, Fisheries Management Service; Dr. M. C. B. Hotz, Director, Integrated Programs Branch, Planning and Finance Service; and Mr. Sharpe, Director Water Pollution Programs Branch, Environmental Protection Service.

The Chairman: Thank you very much. I have already said that the delegation is impressive. I wish to add now that the brief which has been presented to us is also very impressive. I did not dare to bring the third volume with me. It is impressive at least in its quantitative dimension. This presents a problem to us, because we have to print our proceedings for every meeting and we are certainly not going to print the three volumes as an appendix to the

questions we wish to ask you today. Therefore I would suggest that only the preamble, which appears at the beginning of Volume 1, be printed as an appendix to today's proceedings. I believe that most of the remainder is available, certainly Volume 3, in other forms and in other publications. Therefore, since we are against duplication here, we would not wish to reprint those parts of the brief.

I need a motion for this.

Senator Yuzyk: I will make the motion, Mr. Chairman.

Senator Bourget: I second the motion.

Hon. Senators: Agreed.

(For Appendix see pages 16:25-16:30)

The Chairman: Before we move to the question period, I wonder if Dr. Roots or Dr. Weir, or both of them, would like to make an opening statement to us.

Dr. Roots: Thank you, Mr. Chairman; we would like to do that. In particular, we would like to make a general statement regarding what we see to be the role of science in the Department of the Environment, bearing in mind that this is the first time that this department, as an entity, has appeared before your committee. We are, therefore, making our first pitch. We do welcome the opportunity to appear before you for this discussion of science policy and science activities in the federal government. We did not exist as a department when your committee made its first inquiry. We wish to bring to your attention, however, that most of the component parts of our department were functioning and their activities had been reported to you through the agencies of which they were then a part at the time of your first inquiry. Therefore, despite the fact that we are coming before you as a fairly new organization, we feel we bring with us and want to report upon a fairly long tradition of practising science in Canada.

We have taken the opportunity of this review to take stock ourselves as to how we are doing in questions of science policy and science priorities. We are doing this particularly in the light of your first inquiry, because the Department of the Environment was formed in 1970 as a result of the Government Organization Act of that year, just in the immediate aftermath of the first inquiries of the Senate Special Committee on Science Policy. Thus, we are a government organization which was built in the midst of this very discussion in question, of which you yourselves have been the prime movers.

In carrying out our own review we have tried to consider the recommendations that were made by your first inquiry and to see to what extent they were actually incorporated in our department and to what extent we have been able to use them and report upon them in the subsequent years.

I would like to remind you that the Department of the Environment was created from various technical units that

had up until then been part of different subject-oriented departments. Just to give you the range, as a quick overview, I might bring to your minds that there was the Department of Fisheries and Forestry, and those subjects came to the new department. Meteorology came into the department from the then Department of Transport. The whole range of subjects of water sciences, marine research and hydrographic surveys came from the Department of Energy, Mines and Resources. Wildlife concerns were moved as a unit from the Department of Indian and Northern Affairs. Air pollution responsibilities came to our department from the Department of National Health and Welfare. This was an act of synthesis, of bringing together groups of specialists, each with quite different immediate concerns and different areas of expertise, to apply them to an area of broader common concern. We feel that also it was an act of common sense and good management in many ways, because it was good economic and management sense to bring together in a single government structure responsibility for looking after the quality of the land, air and water and the responsibilities for certain important industries such as fisheries and forestry which depended directly upon the quality of air, land, water and our environment in general. It separated those responsibilities, for government management purposes, from the responsibilities of the agencies who had as their primary interest the promotion of economic or resource development ends which might possibly have deleterious effects on the environment and its quality.

However, in addition to good management sense and synthesis, we wish to bring to you a feeling which is within the Department of the Environment that its creation was also an act of faith—an act of faith that the government and people of Canada would be able to have a continuing concern and the will to control their activities to achieve the greatest long-term as well as present benefits from the use of our resources and our environment. Therefore our submission that you received some months ago and our responses to you today, we hope, will have to do with not only the specific actions that we have taken to undertake our jurisdictional mandate and our organization, but how well have we justified that act of faith.

We feel that the success or otherwise of the department will be shown only in part by our priorities on paper or by how well we account, in terms of legislation or its implementation, for the resources provided us. We believe that our success or failure will be shown by the degree to which this department, through its actions, can help maintain a healthy and productive environment in all its aspects for all Canadians, now and in the future, and by improvements in the way in which our resources are used to the maximum net benefit, both immediately and over the longer term.

Perhaps we feel, most important of all, that we should be judged, even in the effects of our science policies, by the influence we have in creating within Canadians a growing consciousness that nature is not an enemy to be conquered, not something to be subjugated, but a lifegiving system of which we are all a part; and by the degree to which the department can help both industrial and political decisions to be made in the realization that our resources are not inexhaustible and simply a matter of economic marketplace stimulation, but something which have been ordained and determined by laws that are not of our making. To achieve this, we feel we have to exploit the opportunities of science and technology in perspective of our social and economic concerns.

These broad philosophical statements obscure the nuts and bolts that make the department what it is, and I want to assure you from the outset that we really are a nuts and bolts department. We have so many nuts and bolts, we do not know where they fit sometimes. Some people may feel we are more nuts than bolts. Nevertheless, this is the way in which we have to work. We have a mandate which gives us a responsibility for the land, the air, the water, and most of the natural living things that are in it, on it, or, in some cases, under it. With that broad mandate, our practical action has to be very definitely at the concrete and specific level. At the most direct level we are engaged, day in and day out, almost hourly, in producing information that affects every citizen. I only need to mention the weather forecasts, the tide tables, flood warnings, international rules to determine how we are to protect the Canada goose and international rules governing the allocation of fishery resources on the Grand Banks. There is an endless number of such things as those which affect the daily lives, both in terms of the amenities, the livelihood and the convenience of every citizen.

Our most difficult task, perhaps, is to relate to broader policies and priorities these diverse individual and specific actions, each of which is necessary and justified on its own merits for meeting a need for information, knowledge, or some essential public service. Yet, the environment itself is integrated and dynamic: you can never catch it; it is always on the go. Little can be done to any part of it without something else being affected. So, in the institutional parallel, the Department of the Environment must be able to relate any of its own activities to the concerns of others in a whole variety of perspectives of time and space.

If there are common themes to what other government departments and the public expect of the Department of the Environment, they are, first, that the department should tell them what is the state of our renewable resources—our clean water, forests, fish, wildlife—and, secondly, what are the consequences, in ways that are quite separate from the intended results, of their own actions—the actions of you and me and the business down the street. One may decide to set up a steel manufacturing plant, for example, but the unintended effects of that will affect the environment, will affect someone else in a way that has nothing to do with making steel. These are the types of questions which the Department of the Environment is expected by the public to answer.

The whole business of pollution control and of environmental impact assessment is based on the fact that while our individual human and economic activities are nearly always justified on a one-at-a-time basis—you do so much work for such-and-such a purpose and get so much for it—the environment is integrated, and everything that is done affects everything else to a greater or lesser degree.

In the course of relating these various activities and responsibilities, and as we gradually learned more about the environment itself, the Department of the Environment has shifted its focus to successively broader perspectives. It is this change of perspective which should be of interest to this committee.

From its inception, the department has had specific resource management responsibilities. In addition to providing technical services in areas such as weather and hydrology, it had responsibility for those industries, fisheries and forestry, which were based directly on the productivity of the natural environment. However, a very important factor in the creation of the Department of the

Environment as a single entity by the Government of Canada in 1970 was the widespread concern that the unneeded or unwanted products from expanding industry, and from our increasingly consumer-addicted society, were beginning, very conspicuously, to overwhelm the assimilative and handling capacity of the local air and water in many parts of the world, including settled parts of Canada. Thus, while from the beginning the department had very specific resource management responsibilities, these were, at the outset, kept rather separate, and in the popular view environmental concerns became synonymous with pollution control. People who were concerned with the side effects of industry became labelled as environmentalists.

As we became more sophisticated about the environment, it came to be realized that policies for the management of specific renewable resources could not be made in isolation from policies for other resources, or policies for the environment at large; and that the control of pollution, while vitally important and often requiring urgent action, was but part of a larger problem that had to do with the ways that we used or misused our total resources, including our resources of land, land space, oceans, clean environments, and healthy ecosystems. Thus, the concerns of the Department of the Environment have broadened from the development or conservation of specific resources and control of the damaging effects of specific activities to questions of integrated and interrelated resource management. This broader view of what is included in the environment—and the environment itself is a difficult thing to define—has brought with it quite a different set of policy and institutional interactions and, to some degree, a different set of scientific responsibilities. For example, instead of being considered to be almost automatically in conflict with industrial development, which was perhaps the reputation we had at the beginning, the department is beginning to act as a partner in the management of our total resources. We are beginning, collectively, not only within the department but throughout the population at large, to look upon the physical and biological environment itself as a resource to be managed or mismanaged, with attendant costs and benefits within the long and short terms.

With increasing understanding of the environment and how it works, we are taking, inevitably, I think, but somewhat hesitantly, a still further step. This step is one of being able to view all of our social and industrial activities in an environmental perspective and acting accordingly. There is as yet no really satisfactory term for this broader environment-resource perspective. It embodies the realization that man is but a temporary steward of a part of the planet, and the degree to which he prospers depends, in large measure, on the care he takes of it. Such thinking is rapidly having an effect, both on our political decisions and on our public expectations. But so far both our bureaucratic institutions and our industrial management techniques have not been very well able to adapt to it.

The Department of the Environment is very directly concerned with how this kind of thinking is being incorporated or handled in the policies of the federal government.

I have talked so far about the change of focus of responsibility and concerns of the department. Almost all of this kind of work has a high scientific and technical content. Policies and regulations regarding the use or protection of the environment or management of resources related to the environment have to be based upon understanding of the characteristics and natural processes of the environment itself. The evaluation of resources, the enforcing of regula-

tions, the monitoring of environmental conditions require scientific measurement and analysis. The essential public services of the department that relate directly to the environment which I mentioned a moment ago—weather observations, hydrographic charts, river flow data—are based on technical operations which, if they are to be useful, and economical and able to meet changing public needs, must be backed by appropriate research and development.

Because of these various activities the Department of the Environment is shown on many lists of Canadian government activities—such as the Ministry of States for Science and Technology reports on science expenditures—as the largest practitioner of science in the federal government.

I would like to make a comment on the fact that we stand out as the greatest spender on science in the federal government. It is in the nature of the subject matter of environmental concerns that the gathering of data and the processing of information is in itself a scientific and highly technical operation. In the submission we sent to you a few months ago, table I showed that 65 per cent of our science expenditures and 70 per cent of our scientific manpower are devoted to essential scientific and technical public services, exclusive of the associated research. This work qualifies as science and related scientific activities, under the definition used by Statistics Canada and MOSST, but it is science which is undertaken to produce systematic public information for whose accuracy we are in some cases legally accountable. It is not science undertaken in the commonly accepted view of research that is aimed at increasing our understanding of natural phenomena, nor is it science which is basically undertaken to provide a basis for policy development or to develop new marketable products or more efficient technology. The basic two thirds or our work is not undertaken for those purposes.

If the scientific activities that we carry out to support legislated programs or to provide essential public technical information are removed, then what we might call the “investigative science”, research and development with investigation as its prime objective which is undertaken by the Department of the Environment, is about one third of that listed in most compilations of federal government expenditures.

What about that one third? What do we use it for? We employ it for a number of purposes. Perhaps most directly our research and the gathering of information on environmental processes are essential to the management of resources. It is also essential to the understanding of the effects of human or industrial activities on the environment, to the assessment of their importance, and to the development of policies or techniques that will help prevent or control undesired effects.

Canada's policies and decisions on resource development and on major development investments are increasingly dependent on the results of such research. Examples of this are in the news every day. From the granting of drilling permits in the Beaufort Sea to the protection of our forests, the Department of the Environment is expected to have expert and immediately available scientific knowledge of the environment, of the potential changes that might happen as a result of human activities and their consequences. And it is expected that governments at all levels would use that knowledge as a basis for their policy decisions.

I want to assure you that not all the scientific work of the department is devoted to “protection” of the environment in its narrow sense, or to the harvesting of renewable

resources. The country expects that a continuing output of high quality scientific information will come from the department in order to increase the safety, efficiency and profitability of many of its vital day-to-day operations.

Much of this work is behind the scenes. Just to give you some examples: our airlines depend on the weather information that is generated on an on-going basis by the Atmospheric Environment Service; the governments of the prairie provinces allocate between them the water of the Saskatchewan River system, which they can divert for their own irrigation purposes, based on the hydrological networks developed and managed by the Environmental Management Service; municipalities and county governments across the country base their development plans and their rural subsidies on land classification and land inventory information developed by the department.

All of these behind-the-scenes services require not only ongoing technical and scientific operations, but programs of scientific research for their improvement.

The scope of potential environmental and resource questions is so wide and the needed information for practical decisions must be so detailed and so specific that the department cannot hope to have adequate scientific information on all likely problems in advance.

Ideally, the department would like to have a balanced and a continuously ongoing program of study of renewable resources, of the basic characteristics of the environment, and of our use of the environment, in order to develop and organize a growing body of knowledge that would meet the country's demands for policy management and information. In that case special studies would only then be needed for unexpected events. The present situation, however, is that due to the increased and urgent demands for environmental information and appraisal, and the progressive decrease in real terms of our scientific capacity, the department is forced to apply most of its resources to technical operations and to confine nearly all of its research to short-term urgent studies. In many fields it is unable to maintain a continuing planned program of environmental research. As a consequence, and we feel we should lay this before you, that while our knowledge of the Canadian environmental processes is growing, it is less well organized and perhaps less useful than many of us in the department feel that it should be, given the size of our scientific establishment and the magnitude of our expenditures on what is categorized as science.

I want to also lay before you the point that in the Department of the Environment, science is not a subject or an activity that can be set aside from the rest of the departmental operations or justified on its own grounds. Scientific activities are one tool,—an essential and often a principle tool—by which the department discharges its mandate. We find ourselves, frankly, at a loss when we are asked to analyze our policies for science as distinct from our policies for the department as a whole, or when we are expected to justify expenditures on science separately from expenditures on non-scientific operations.

It is useful, of course, to compile information on scientific expenditures the so-called science budget; it serves a purpose, for it helps us to identify trends and it may give warnings of deficiencies or imbalances. But to use such information for program control or operational management purposes, in the sense that scientific activities can be assessed separately from the activities of the department of which they are a part, is, in our view, mistaken and sometimes misleading.

I want also to make a point, if I may, that scientific activities of the Department of the Environment are mission oriented. In making that statement I do not deny that a great deal of our best research is undertaken with a strong desire to find out more about our environment. Much of our science undoubtedly owes its originality and, to be honest, its very excitement, to a curiosity in the mind of the scientist as to what it is that makes nature tick. But none of our scientific programs is undertaken primarily to satisfy such curiosity. Our programs are undertaken to provide the basis for policies and regulations; to assess our resources to determine how best to use or conserve them, and to enhance our ability to recognize and define environmental problems that will enable us to understand the values that society places on the environment. Thus our curiosity and our desire to know, in the research programs of the department, is always subsumed by the identified need to know, to understand, and to take action on that knowledge.

We are aware, Mr. Chairman, that your committee is interested in who it is that carries out the research and the related scientific activities needed by government departments. How much of this is done in-house, and why? How much is contracted to industry, and what are our relations with university research?

We have tried in our submission to give you the relevant numbers and comments on our policies. In these remarks I would like to make just two points on the "make or buy" policy. The first is that the records will show that the Department of the Environment has led the federal government departments in scientific work contracted to non-government performers. Moreover, they will show that we, or the operating units of which we are now comprised, have been contracting out for a long time. We endorsed and put into practice the "make or buy" policy long before it was formalized as an official government policy; for in the environmental and resource assessment field it simply makes good management sense to have certain parts of the work done directly by industry or by private contractors. But we also know, from trial and error, instances where it is not applicable, or where its effect on science is not positive. Thus, although we strongly support the policy and carry it out wherever it can be applied to our own needs, we feel that we have experience on which to base a somewhat tempered view of its universal application. The second point is that the announced justification for vigorous application of the "make or buy" policy—namely, that transferring government scientific work from in-house laboratories to industry will stimulate industrial innovation and technology transfer, and thus lead to more competitive and profitable Canadian industry—has little relevance in many cases for many of the scientific activities of the Department of the Environment. The research and development with which the federal make or buy policy as a whole is concerned is mostly that which will lead to better products and techniques that can be sold on a wider market, and the "industries" that are expected to benefit are very largely the manufacturing and services industries. Although there are conspicuous exceptions, such as with our program of pollution abatement technology, by and large the scientific activities of the Department of the Environment are not of the type that are directly relevant to the immediate development of marketable products, and the contractor who provides scientific services to the department is very rarely able to turn around and find a large number of national or international customers for his new knowledge. A great deal of the scientific work of the

Department of the Environment tends to be one-of-a-kind, sharply focused on a government need, dealing with a common property resource, leading to information in the public domain or to techniques that are not readily sold to others. Thus, while the make or buy policy will continue to be applied and expanded by the department wherever relevant, not very much of the contracted science can be expected to have industrial spin-offs of the type envisaged in many statements that have been made to justify the policy in general.

I would like to say a word about the setting of priorities for scientific work. One of the subjects of interest to your committee is how our priorities for science are selected. As I have explained, the scientific activities of the Department of the Environment are an integral part of the total operations of the department, and so our programs in research and information gathering are tied directly to our departmental priorities and commitments. The two-thirds of our scientific activities that are devoted to essential public services, as just referred to, can be altered substantially in priority only by a major political or policy decision. We cannot, for example, decide on purely scientific grounds or departmental authority whether meteorological services for one city are more important than those for another, or indeed whether either takes priority over revision of the navigational charts for a particular harbour. The area where the department does have some discretion is in how much of its resources it can apply to continuing background base-line studies and long-term research on environmental processes, and how much it must devote to urgent specific studies to meet short-term demands for action. But the pace of events, and the intense public or political interest in particularly conspicuous environmental-related issues, is such that this discretion has in many cases all but disappeared. With the present restriction of scientific resources and the increasing demands for urgent "fire-fighting" science, the department is seriously in danger of losing control of its own priorities. In the overall view of the serious environmental problems facing Canada, for example, it may well be that the localized concentration of toxic metals in certain fish may be of less significance to present and future Canadians than the subtle but widespread changes in the fish habitats as a whole. But if there is public concern about a possible health hazard from contaminated fish, there is little alternative for the department but to interrupt the broader and ultimately more significant study and focus on the urgent crisis. In cases like this, careful research is needed; but one cannot expect a research program launched as a result of a crisis immediately to resolve that crisis.

One aspect of the priority-setting problem that we wish to bring to the attention of this committee is contained in the dual anticipatory and responsive role of the department. The Minister of the Environment has little choice but to attempt to be all things to all men in the environmental field. There is little he can say "No!" to. We cannot say that we will do nothing about the possible environmental effects of a proposed nuclear power plant because we are really concentrating our efforts on the effects of the Mackenzie Valley pipeline, or that we will not recognize the resource management responsibility of a 200-mile off-shore marine limit because we have used our resources studying the control of the spruce budworm in our forests. Moreover, we cannot operate to any extent on an expenses-recovery basis as far as our scientific activities are concerned, because to be effective, a great deal of the environmental scientific work and resource assessment should be

done in advance of the first decision by government or industry whether or not to undertake a project, and be part of that decision not a consequence of it. One of the department's most serious problems is the lack of resources and scientific capacity to have environmental information ready for input into the initial decisions on major development projects. Because of this lack, the department is chronically in a "catch-up" position, and environmental concerns are tacked on as constraints and nuisances to plans already made, instead of being an integral part of the original decision that could have contributed to the economy and effectiveness of the enterprise.

In describing our difficulties in taking action when it would be most effective, I do not want to give the impression that the department operates in an *ad hoc* and hand-to-mouth manner. Each of our services has a solid core of activities based on scientific and technical operations that has been built up over the years in response to the legislation, policies and commitments for which we are responsible. The essential scientific public services that comprise two-thirds of our work, as already mentioned, give us a scientific momentum and intimate contact with both the public and the scientific community in all parts of the country, as well as internationally. On this base of ongoing work and contacts, we have attempted seriously and deliberately to consider where we should be going, both in the immediate and more distant future, and to plan how we should try to get there. I believe that we have had the most consistent and long-lasting program of specifically identified "futures studies" of any federal government agency. We have made, as you know, a separate submission to you on this subject. Both departmental headquarters and several of our regional boards across the country have programs of long-range outlook or planning, wherein we attempt to foresee what will be expected, in terms of responsibility and policy, of the federal government in the environmental field in the years ahead; and then we have considered what programs and research will be required of the Department of the Environment to meet those needs. We have compiled and extensively discussed a series of scenarios, trend analyses, ten-year plans and workload forecasts. Out of all this comes a rather sobering and some might say pessimistic picture of economic, social and resource problems ahead, in which environmental considerations and resource realities will play an integral and increasingly important part. The need for carefully planned, high quality scientific work in the environmental and renewable resources field will clearly continue to increase. How that need will be met, in terms of departmental resources and national scientific capability, is a very serious concern to all of us.

Finally, I want to point out that the environmental responsibility of the federal government will not be, and never has been, a responsibility of the Department of the Environment alone. It is a truism, but also a fact, that no agency or person can operate outside the environment. In our current reviews of environmental issues and need for policies relating to the environment, a department-wide committee has been identifying and preparing positions on areas of concern to which it can be expected that the Department of the Environment will be giving principal attention in the next decade. These areas are, in themselves, rather obvious: food, energy, industrial activity and materials, settlements, transport and communications, cultural and social concerns. None of these subjects is, in its jurisdiction, primarily the responsibility of the Department of the Environment, but environmental and resource

factors are a vital part of each. They are, of course, simply a list of the major problems facing mankind, with questions of population and its distribution running through all of them. The task of the Department of the Environment, as we see it, is to bring the best possible scientific understanding of the environmental and resources aspects to the policies that will have to be developed and implemented by Canada in these areas.

Not only are the major concerns of the department shared with other departments of the federal government, but they are intergovernmental and international concerns as well. Thus, the scientific work and the science-based policies of the department have direct implications for other governments. For example, 90 per cent of all Canadians live in water basins shared between provinces or with the United States; thus our knowledge about the hydrology of these river systems and the quality of their water is vital to both provincial and international concerns. The Canadian environment is part of the world environment, and Canadians are affected by changes in the world-wide environment, such as, for example, variations in climate. We not only benefit from, but have a responsibility to contribute to, advances in world science concerning the environment and resources. Canada's scientific activities in the environmental and resource field are unavoidably a part of international science, and the quality and relevance of our own science and its effective use in our own policies are very much dependent on the effectiveness of the interchange of scientific information with other nations. Thus, the Department of the Environment places great importance on international scientific contacts and participation. With the restriction of funds that all government departments are experiencing, and in particular restrictions on resources available for science and research, it becomes progressively more important that we maintain this participation and take advantage of the widest possible pool of scientific knowledge.

There are five aspects of the scientific work and policies of the department which I would like to leave with you. These are not unique, but they are particularly characteristic of environmental concerns. They are, first, the very broad scope of subject matter, and thus the essential need for access to an almost endlessly wide range of specialist expertise and scientific activity. This does not by any means say all expertise has to be encompassed within the department, but the department cannot operate unless it has access to it.

Another characteristic is the fundamental role of inter-relatedness between apparently unconnected or separate subjects. This applies not only to the natural environment but also to our institutions when we attempt to devise and evaluate policies that control activities affecting the environment or resource use.

Another characteristic is the need to compare and relate dissimilar, often non-quantifiable, elements. There is a saying that, "Environmental management is the art of trade-offs between apples and oranges," and there is a lot of truth in that. This need challenges the department to search continually for better ways of describing, modelling, quantifying, comparing and assessing environmental and resource information.

Another characteristic is the time factor. All environmental issues have both an immediate and a longer term element, and the two are frequently in conflict. As our knowledge of the environment grows, increasingly we are finding that our present actions are foreclosing future

options for beneficial uses of the environment. Thus, to an increasing degree the scientific strength of the department will have to be devoted to obtaining understanding of what we may be doing to our own future. This raises the problem that our expenditures on science may not be justifiable in terms of current government priorities or goals, and the pay-off will be, quite deliberately, beyond the time span of immediate political concern.

Finally, a very important characteristic is that the questions we have to face in our scientific activities in the department present a challenge to our present lifestyles and habits. The Department of the Environment is perhaps in the forefront of the federal agencies questioning the established scheme of things. There is little doubt that our present patterns of resource use and conventional economic motivation cannot continue indefinitely without important change. Environmental factors, including the limitations of resources, will be prominent among those things that will cause these changes. The changes will be fundamental and will affect every one of us; they may take in an orderly fashion or in an unplanned and, possibly, catastrophic way. Knowledge of the state of the environment and its behaviour, of our resources and the many ways that we might use, conserve or enhance them is central to policies and activities that will allow orderly change. Thus, the Department of the Environment feels it has a heavy responsibility to ensure that its scientific activities are designed to help Canada make the most of its environmental opportunities, and at the same time recognize its environmental and resource realities in coping with these fundamental changes.

Mr. Chairman, I have spoken at some length, perhaps too long, about the department as a whole and the integral part of scientific activities in our total operations. We have, however, an agency which stands somewhat aside from the line operations of the department, and which is devoted almost directly to a review of and concern with scientific matters *per se*. That is the Fisheries Research Board. Its policies and its influence on research in Canada, and in the department, are very important to the department as a whole. With your permission, Mr. Chairman, I would like to ask Dr. Weir, Chairman of the Fisheries Research Board, to say a few words.

The Chairman: Before we proceed with this second stage presentation, I should like, first of all, Dr. Roots, to thank you very much. I do not want to appear critical at this stage, especially because you are a new department, but some of our former clients know that although we are good listeners we are also good readers and questioners. I wish that perhaps this presentation, which is very interesting, could have been forwarded to us beforehand so that we would have had more time for questioning, because we have only, at the maximum, another two hours to spend with you. In any case, it has been done, and I am sure that when you come before this committee perhaps four or five years from now we will be able to improve on the procedure.

I believe that we should now hear Dr. Weir, and then perhaps adjourn for six or seven minutes, after which we will proceed with the questions.

Dr. J. R. Weir, Chairman, Fisheries Research Board: Mr. Chairman, honourable senators: On behalf of the Fisheries Research Board I should first like to thank the Department for arranging things so that I could be here. Secondly, Mr. Chairman, I should like to thank you for taking the time to hear my comments.

You have not received from the board or from myself any background material, first of all because we were outside of the line system of the department and we were not involved in the preparation of the material at all; secondly, the kind of information that we have available I can now refer to very briefly, and make further comments in reply to questions.

The Chairman: That is separatism in fact.

Dr. Weir: The Fisheries Research Board operates under an act of Parliament which stipulates that there shall be a chairman and not more than 18 other members, the majority of whom shall be scientists. The board reports directly to a designated minister. I might just say that of the 18 members of the board there are no federal government people; they are representative of universities, industry, provincial research institutes, so that it is quite a different structure. The board is broadly representative of national interests in fisheries and aquatic sciences, with membership, as I said, drawn from universities, industries and provincial research organizations. As chief executive officer of the board, I serve as a member of the senior management committees of the Department of the Environment and also the Fisheries and Marine Service. This permits me to keep the board informed of new developments pertaining to its statutory responsibilities; and to reflect the general views of the board in matters pertaining to policy formulation.

On January 1, 1973 the role of the board was changed by The Honourable Jack Davis, then Minister of Fisheries, from a board charged with "conduct and control" to an "independent advisory board".

I might just say in that respect that the board had just completed 75 years as an independent research agency in the aquatic and fisheries field under its own act and was, might I suggest from a traditional and historical point of view, by far the oldest of the Canadian research agencies of such a nature.

The board is fully satisfied that it can serve the minister and his government well in its present independent, advisory role; however, it reserves judgment on whether all aspects of the January 1, 1973 transformation will ultimately prove to be in the best interests of the nation.

Under this new charge the board has undertaken a number of independent studies on various topics pertaining to fisheries and the aquatic environment. These are now being integrated into a national overview of fisheries and aquatic sciences to be submitted to the Minister of State for Fisheries in November of this year. The value of the board as a national spokesman for valuable common property resources should not be underestimated.

With respect to the type of information, we have conducted our studies by having background studies done by selected people, some inside, some outside the government. These are appearing as individual reports. This is on biological oceanography in Canada; here is one on the science for Canada's shelf sea fisheries, which was done just as the Law of the Sea Conference was developing a need for background information on that subject. We have some 12 other studies encompassing the present situation of research and development in the fisheries and aquatic field, with some attempt to advise and recommend on future actions and changes in research that could be made in this field. We are preparing now an overview based on these studies and other activities. As a matter of fact, we are having a workshop in the first week of September, to

which outside people are invited. One of these people who will attend our workshop for two days is Mr. Beverton, who perhaps you have met, the Secretary of the National Environmental Research Council of the United Kingdom. He has finished a five-year period in looking at the management of research and has been an influence in outside financing and so on.

Dramatic changes have taken place in respect to fisheries and the aquatic environment in the last decade. There has been a shift in public attitudes from environmental indifference to environmental consciousness. As a result of pollution and resource problems, potential and real, there has been an increasing accent on international concerns on the east and west coasts, in the Arctic and in numerous boundary waters, particularly the Great Lakes. Increasing attention has been given to social disruption accompanying depletion of fish stocks, particularly on the east coast. In scientific studies the accent has changed from single species to ecosystems, from descriptive mapping to dynamic modelling, from unidisciplinary to multidisciplinary approaches, from rehabilitation of fish populations to fish culture, from natural science studies to fulfilment of social needs. The tools available for the study and management of aquatic resources have undergone marked changes. We have automated chemical analysis, refinements in computer modelling, increased sophistication in underwater drilling and exploration, improved technology in both primary and secondary aspects of the fishing industry. In large part due to the activities of this committee, the Canadian scientific and technological community has become more actively interested and involved in developing federal science policy.

One may well ask why, with the increased attention given to fisheries and the aquatic environment and the increased sophistication of technological tools, our renewable resources are not now in better order. Among many reasons, two are notable: first, the pressure on the environment has increased due to momentum and time lag effects associated with a continuation of past trends in resource consumption, nationally and internationally; and, secondly, our comparative lack of understanding of how ecosystems work. In regard to this, even though equipped with twentieth-century tools and science, our knowledge of the structure and function of aquatic ecosystems, in terms of our ability to manipulate them, is really comparable to the state of knowledge of medicine and surgery that existed in the 19th century. As one example, if one were to travel the length of any Canadian river from its source to its mouth, collecting the fish food organisms living on the bottom, more than half the species present would be new to science. Their life histories and ecological roles have yet to be described. The above reasons may help to explain the heavy expenditures of the Department of the Environment on research and development.

I would like to say a word on the management of fisheries and marine science. Effectiveness in research demands good guidance from policymakers and excellence in the individuals involved in research. The organizational pivot on which success or failure hinges, in my opinion, is the research manager. He is the feedback communication channel between the political desire and scientific capability. With the increasing specialization and compartmentalization inherent in matrix management the research manager has to a large extent been diverted away from the management of research into acting as a quasi-administrator who spends a considerable fraction of his time trying to patch up administrative problems not of his own making.

Effectiveness in research effort demands a favourable research "climate"—a certain level of complexity of the problem, comparative protection from distracting, short-term interferences over the time framework typically associated with research problems, such as is often spoken of as from two to ten years for particular investigations, up to even a lifetime in general areas of investigation; and the feeling of an open channel of communication that enables pertinent research findings to make their way to the "top." The prime responsibility of the research manager should be the maintenance and improvement of that climate. While the board has not made an intensive study of this matter, the information it does have on hand suggests that there has been a marked deterioration in climate and morale in federal research laboratories dealing with fisheries and aquatic sciences in recent years. The board will be addressing this subject in its overview of fisheries and aquatic sciences that I mentioned previously as being under way at the present time.

A word, Mr. Chairman, about the universities and federal government in research. The links between the universities and the federal government have weakened in recent years. The attitude of the government is perceived as anti-research; the funding of research grants has not kept pace with inflation; the funding of multidisciplinary projects by granting agencies has, in general, been more difficult than that of unidisciplinary projects; and the implementation of "make or buy" policy mediated by the Department of Supply and Services has not favoured the universities. Federal research laboratories involved in fisheries and aquatic sciences have suffered a three to four-year drought in the hiring of undergraduate students as summer research assistants. If continued, this trend is likely to have serious repercussions on future recruitment of experienced professional staff into the public service.

International exchange, via post-doctoral fellowships and, in the Public Service, professional development leaves, appears to have declined. In areas such as oceanography, where university staff are dependent on federal institutions for research vessels, restrictions on future ship time are viewed with apprehension. In short, the link between federal and university research establishments, which is vital to the health of both, is generally perceived to be weakening.

I should like to add a word or two, Mr. Chairman, on the commonly referred to topic of basic and applied research. This goes back some eight years.

The Chairman: You need only go back to this morning when we were told there was no difference.

Dr. Weir: This committee, in its three-volume report entitled *A Science Policy for Canada*, made much use of the terms "basic" versus "applied" research and "curiosity-oriented" versus "mission-oriented" research.

The Chairman: May I just interrupt to say that we did not invent these distinctions. They were first defined by scientists themselves.

Dr. Weir: In re-opening its inquiry into a science policy for Canada, I believe the committee may find it more useful to adopt the definition of basic research used by J. H. Comroe and R. D. Dripps in an article entitled, "Scientific Basis for the Support of Biomedical Science"—the reference *Science*, Volume 192, pp 105-111—namely, research that "attempts to determine the mechanisms responsible for the observed effects." This definition more

accurately reflects what most scientists mean by "basic" research than other, counterproductive definitions that erroneously attempt to classify research as "basic" and "applied" as if these were mutually exclusive terms.

The Chairman: I hope you are not quoting our report now.

Dr. Weir: No, I am not, Mr. Chairman. I am simply presenting this as an argumentative base. Comroe and Dripps found that 62 per cent of the work judged essential for the development of the 10 most significant clinical advances in cardiovascular and pulmonary medicine and surgery during the past 35 years was basic research in terms of their definition of research. Also, they reported that 41 per cent of the key background advances were not clinically oriented at the time the work was done. These results have important implications to federal science policy. A proposal to undertake a comparable analysis in the area of fisheries and aquatic sciences is currently being considered by the Fisheries Research Board. We want to be able to determine why certain programs paid off, how long it took, and the factors involved.

It is now possible to calculate the effectiveness of basic research as described above, and if we accept this procedure we can arrive at some measure of the impact of the present reduction in research support for science in general, and the renewable resource area in particular.

The Chairman: Before I ask Senator Lang to lead in the question period, I would like to refer to your volume 1, table 2, and before this is printed as an appendix to today's proceedings, I wonder if you could, for the printing, explain, on describe in a footnote or somewhere, all the symbols that you are using there because at the moment, at least for me, it is rather incomprehensible, except BI and CH or something at the beginning.

Dr. Roots: Certainly, sir, we can do that.

The Chairman: Senator Lang?

Senator Lang: I don't know where to start, Mr. Chairman—at the back, or the front, or in the middle. But by way of openers, Dr. Roots, under this department you have merged many various activities which could be described in one way or another as having an effect on the environment. Do you think by this sort of reorganization into a department that anything of a synergistic nature has been accomplished, or have you got the sum total of what was there in the first place? And what is the reason for your answer?

Dr. Roots: Well, sir, I think very definitely there has been action of a synergistic nature. It has taken longer to achieve this perhaps than was hoped when it got started, but we feel that gradually we are creating, collectively, a department whose whole is greater than the sum of its parts. This is coming about very largely because the kinds of concerns that are being thrust upon the department cannot in themselves be answered by the capabilities or responsibilities of any one of its component units.

The kinds of questions that I mentioned in my address a moment ago, of food, energy, settlements and so on, cannot, in the way that the federal government must give answers concerning these problems, be delegated exclusively to a marine service; or an environmental management service, or answered from a forestry aspect or an environmental protection aspect alone. We find increasingly within the

department that the problems that we are having to face on a day-to-day basis require an interaction between our various services. This, in itself, is creating a department which is more of a unit than it was a few years ago. Perhaps administratively and from the point of view of finding a mechanism for deciding on allocation of resources and things like that we are not as efficient an operating single unit as was hoped when the department structure was set up; but from a synergistic point of view the department is gaining momentum and is making headway.

Senator Lang: I always find difficulty in relating federal activities of this nature with those of the various provinces. How do you inter-react with the common responsibilities of the provinces in these areas? Basically, apart from, say, ocean fisheries and navigable waters, you are dealing with, I think, basically the subject-matter under section 92.

Dr. Roots: Most of our relations with the provinces are on specific subjects. Perhaps I could refer this question to Mr. Bruce. Would you give some examples of how we inter-react?

Mr. J. P. Bruce, Acting Assistant Deputy Minister, Environmental Management Service: I think there are some clear federal responsibilities here, and you have identified several of them, sir. There are others related to boundary waters, interprovincial waters and, as you pointed out, navigation questions, and there are questions relating to migratory birds which clearly fall under the federal responsibility.

Many of these areas seem to us to be areas of joint jurisdiction where there is federal legislative jurisdiction but the province owns, to a large measure, the resource. In those areas we have worked very diligently to develop co-operative federal-provincial approaches, and we do this through various kinds of mechanisms. Under the Canada Water Act there are consultative committees on water established between the federal government and individual provinces. We have signed environmental accords with most of the provinces which allow us to co-ordinate our activities in environmental protection work, so that in these areas of shared jurisdiction, we have a basis on which to develop very good federal-provincial relationships, to ensure that we do not overlap each other and that we work in concert to achieve common goals.

Senator Lang: How does this federal department interact with the International Joint Commission? Your concerns must be identical in connection with the condition of the Great Lakes, I would assume.

Mr. Bruce: Yes, very much so. The International Joint Commission is a quasi-judicial body which consists of only six members plus a very small supporting staff, so that all of the technical work is done by federal agencies and, in some cases, by provincial agencies. Our agency is perhaps the most heavily called upon by the IJC to carry out studies after an agreement has been reached with the United States, to ensure that that agreement is being kept. Right now I believe that our department fills about a hundred positions on boards, committees and reference groups of the International Joint Commission. Each one of these requires back-up technical and scientific information to carry out scientific work. These are study boards and boards of control. For example, our people provide the input as to how to regulate the levels of the Great Lakes

within a framework established by the International Joint Committee.

Senator Bourget: Is the Ministry of Transport doing part of the job also?

Mr. Bruce: The Ministry of Transport is another of the agencies which the IJC calls on for work in this connection. On the international board which looks after and regulates Lake Ontario, there is a representative of the Ministry of Transport and a representative of our department. But the technical work is done by our Great Lakes-St. Lawrence study office in Cornwall, which is a technical office supporting the Canadian section of the board. One of the things that is very important here to keep in mind is that it is very difficult for us to match the United States in economic influence, but we do try very hard with the resources we have available to match them in technical skills; and I think that only in that way can we deal effectively with the boundary water issues and air transport issues.

Senator Lang: Have you been involved very much in the Garrison Dam project?

Mr. Bruce: Very much so.

Senator Lang: And something to do with the mine operation on the B.C.-U.S. boundary line? Whom do you advise on that?

Mr. Bruce: Well, in the first case, the Garrison diversion—this was a case where for a number of years we advised External Affairs on the scientific and technical information which led us to believe that if the Garrison diversion plan were to proceed as planned in North Dakota it would have adverse effects on water quality and on flooding in the Souris River and the Red River in Canada. So we did all the technical studies, based on material supplied by some of our colleagues in the United States. This demonstrated to us quite clearly that there would be adverse effects. External Affairs used that ammunition in their dealings with the United States and then we finally agreed that the only way to resolve the issue was to ask the International Joint Commission to undertake a study. The International Joint Commission was given a reference and then it came back to us and said, "Who are your best technical people to deal with this?" So we now have people working 84 hours a week trying to complete that reference study, and they come from all parts of the department—from the fisheries side and from the inland waters side—trying to come to grips with a joint appraisal with the Americans to see what impact that proposed diversion will have on Canada and how it ought to be modified to ensure that those adverse impacts do not occur.

The Chairman: When you speak now of the International Joint Commission you are really referring to the Canadian section.

Mr. Bruce: No, the studies that are undertaken by the International Joint Commission are joint studies by a joint board appointed by Canadian and U.S. technical people. What we are trying to arrive at is a consensus with our U.S. counterparts on the technical facts of the case upon which the IJC can then make a recommendation to the government.

In the case of the potential problems of coal mining in BC affecting rivers in the United States, that has not as yet reached the stage where a reference to the IJC has been

given. We have close contacts with the B.C. government on the development there, and we have initiated a monitoring program so that we know what the natural state of the river system is, prior to any developments there, in case such developments do go ahead. This will allow us to be ready for questions as to the effects of the development on water quality in the United States.

Senator Lang: Where does this fall in the line of chain of command within the department? Under which assistant deputy minister does it fall?

Mr. Bruce: I might go back to Dr. Roots' earlier comment. Questions that come up under the boundary waters issue and questions of air transport pollution involve a number of parts of the department. We are now able to call on people within the department with expertise in fisheries and related aquatic sciences, in water and atmosphere resources and a whole range of expertise that previously was scattered over various parts of the government.

Senator Lang: And then it comes up to the senior assistant deputy minister, environment services—is that the chain of command?

Mr. Bruce: In some cases, yes but in some cases it involves, for example, fisheries services, which would be under a different senior assistant deputy minister. So the only real head is the deputy minister.

Senator Lang: Coming back again to Dr. Roots, you have a substantial R and D budget by comparison with other departments. I am just looking through some of the figures here. How does that budget compare with, say, the combined budgets of the various components that now make up the department, as compared to 1968? Does that merely reflect an allowance for normal increases and inflationary factors, or are you utilizing a much larger budget on R and D than the components did from 1968 to 1970?

Dr. Roots: I think, on the whole, the relative proportions are quite constant over this period, for those components that still carry out the same functions. Perhaps I could call on Dr. Hotz to deal with this.

Dr. M. C. B. Hotz, Director, Integrated Programs Branch, Department of the Environment: Mr. Chairman, it is very difficult to go back to 1968 because this would mean having to cull information from a number of government agencies having a wholly different set of priorities and expenditure categories. So what we have done is to take figures from the time of the formation of the department in 1970-71; and when you do that you find that there has in fact been an increase, in R & D spending. I will give you a few dollar figures for the record. In current dollars, from \$73 million for R & D expenditures in 1970-71 we go to \$122 million in 1976-77; I am just covering the period of the existence of the department because the figures for 1970-71 are figures that came from the original agencies from which it was formed. So the figures in current dollars show a steadily increasing trend. Unfortunately, the deflated figures that we have relate to total science expenditures, and not solely to R & D. These show the same sort of increase as for current dollars, with a few ups and downs in between. You will find that we hit our real peak in 1972-73.

The Chairman: This is total science?

Dr. Hotz: This is total science, yes, but proportionately there have not been any major changes, although there

have been some shifts away from research into other Related Scientific Activity. We find that in terms of both current and constant dollars, we hit our science budget peak in 1972-73. We went from total deflated expenditures of \$157 million in 1970-71 to \$190 million in 1972-73. We then dropped the next year to \$170 million, and since then we have been up and down around \$185 million. We have not at any time again hit our peak—this is in deflated terms—of \$190 million in 1972-73. What has in fact happened is, that in order to maintain some of our ongoing programs, the science and research managers have been forced, at the time of preparation of their program forecasts, to divert money that had previously been identified by them for capital purposes, that is, for small capital equipment and things like that, into operational funds. I can remember in one year some \$10 million being so transferred. This was before the preparation of the estimates, of course. The inflation of the last couple of years has now resulted, in some cases, in as much as 80 per cent of the operational budget being spent on salaries.

The Chairman: Does that mean that you can pay your researchers but that they have no equipment to work with?

Dr. Hotz: I think that we are relying on the equipment that we already have, and hoping and praying that it does not fall apart, that everything we had last year does not fall apart next year.

Senator Lang: In a broad, general sense, where is the bulk of your R&D expenditure going in terms of these various sub-departments, such as marine aquatic biology, hydrology, wildlife, air pollution, pollution control? Where does the weight now lie?

Dr. Hotz: This is a rather difficult question to answer. I think we have seen a proportionate increase over the last several years in atmospheric research. Research done by or for the Environmental Protection Service is largely new, but is very limited. The research needs of the Environmental Protection Service are met to some extent by the Environmental Management Service on the water side, to some extent by the Fisheries and Marine Service and by the Atmospheric Environment Service. On balance, I do not think there have been very major proportionate shifts in research between the various parts of the department.

Senator Lang: You mean it is maintaining the status quo?

Dr. Hotz: Not the status quo, because before the department was formed there had already been shifts in research direction toward environmental quality and away from exclusive orientation on resource orientation. The resource oriented research of the other agencies had to be carried on though, so it was rather difficult to maintain a balance between them. When the Department of the Environment was formed one of the first things that had to be done was to get started on a pollution control program, and the Environmental Protection Service was set up specifically for that purpose. This tended to produce further shifting towards an emphasis on research aimed at maintaining environmental quality. We are now looking at a much more synergistic situation than we had before, where the work of one agency is closely affecting that of others, and where it is becoming less easy, I think, to see where the research thrusts are originating, because they are transcending the specific subject interests of the Services into which the department is organized. For example, there are a number of areas where joint projects are going ahead

that involve Fisheries personnel as well as Environmental Management Service personnel. This type of program is increasing steadily.

Senator Lang: It is a complicated picture for us to grasp quickly. I think perhaps by examples you might help elucidate. For example, has the Department of the Environment been involved in the current question of mercury poisoning in the Grassy River Narrows Indian Reserve. If so, what action has the department taken, under what circumstances, and what may the present status of the matter be?

Mr. W. K. Sharpe, Director, Water Pollution Programs Branch, Environmental Protection Service: With respect to mercury, we have been in consultation with both Ontario and Quebec. There are several factors with regard to the mercury inputs with respect to water. The mercury inputs have been reduced down to about 1 per cent of the original contributions in that area, and we are looking at other contributions, including atmospheric contributions. The whole question of mercury has been discussed before one of the House of Commons committees. I was not present at that committee hearing, and I should like to refer those minutes to you at some later time after I get back to the office in order to answer your question more fully, if I may do so.

Senator Lang: My question was really directed, not so much to the substance of the matter of mercury poisoning as to by what mechanics, other than a newspaper story, do these matters come to your attention, and how do you deal with them?

Dr. Roots: We could only wish that there were a single identifiable pathway by which some of these questions come to our attention. On a question such as you raise as an example, the first areas of responsibility are, as you well know, the provincial governments, and, with respect to Indian reserves, the Department of Indian and Northern Affairs. The Department of the Environment will be in most cases—and the example you mention is a case in point—consulted by both of those regarding any technical information that we may have. Their request, and our response, would not necessarily imply a direct action responsibility, other than under our established legislation and a consideration of what may be done by way of dispersing information or gathering more, in the name, you might say, of humanitarianism first. The request we receive could be either formal, as in an example like this, from the minister of another department or another government level, or it could be initiated informally and start within the department. The Department of the Environment would identify either a team or lead agency, usually under the responsibility of the assistant deputy minister, to take what action is required. It may be that Dr. May or Mr. Hurtubise has some information on just what we did in the Grassy River Narrows case.

Mr. F. G. Hurtubise, Director General, Environmental Conservation Directorate, Environmental Protection Service, Department of the Environment: This is a general question and if you will allow me, sir, I would like to answer it in a very general way because, obviously, as I am sure you know, the problem in dealing with mercury contamination in our stream is that there are deposits of mercury which are a result of industrial activity which has occurred over the past many years. Now, the Environmental Protection Service, being the pollution control agency, if you wish, of the Department of the Environment, in 1972

decided that one of the first things it should do would be something about the effluents from chlor-alkali plants. Very soon after the formation of the Department of the Environment effluent regulations for the chlor-alkali industry were promulgated. As Mr. Sharpe has indicated, this immediately reduced the effluent discharge of mercury from such plants by 99 per cent. Of course, the problem remains of the accumulated deposits in the rivers, which is what is really causing the problems we face today.

Besides these various systems we have for exchanging information between provincial agencies and ourselves, we also now have, since April 1 of this year, the Environmental Contaminants Act. This act has been established in order to prevent a situation such as mercury or other contaminants that we are now beginning to hear about and which have been around for a long time. I will not go into the details of the Environmental Contaminants Act, but I believe it will help in establishing what we are doing in this area to describe a facet which we like to refer to as an early warning system. Basically it goes like this, that if a manufacturer is importing or manufacturing for the first time a chemical, in amount more than an initial quantity, I believe more than 500 kilograms, this must be reported to the federal government within a certain allowed period of time. This report automatically alerts the Department of the Environment to the introduction of a new chemical which might have either health or environmental impact. So we hope through this new legislation in effect to prevent problems that we have experienced with other chemicals. Mercury is one, of course, and I am sure you have heard of PCBs.

Senator Bourget: So it is done by way of regulation rather than research, is that it?

Mr. Hurtubise: No; unfortunately, depending on your point of view, there is a tremendous need for much technical work to be done because suppose a new chemical is synthesized, then someone finds a use for it and immediately, of course, someone decides to market it. However, before we allow the marketing of this product from now on in Canada, we will insist that first of all we have a good assessment of the potential environmental or health impact of the product. I would like to say, right away, that we are operating very closely with the Department of National Health and Welfare. Our two departments have dual responsibility; they have the responsibility for the health impact while we have the responsibility for the environmental impact of new chemicals. We want to know everything that is known on either side. This presupposes, as we have said already, that we are very much aware of what the scientific community is doing. I would like simply to reinforce one comment made here already with respect to the great need for scientists in our department to be *au courant* with what is happening internationally in the whole area of environmental sciences. This is crucial to the very existence of our department. So we should know what is happening from the point of view of research into the question of the environmental and health effect of all these new chemicals which appear on the scene. It is a very large number per year, unfortunately.

The Chairman: Perhaps another way to go at the general question that Senator Lang had in mind would be to ask you, sir, to describe perhaps more precisely than has been done so far the responsibilities and functions of your office. As science adviser and co-ordinator, presumably all these requests should go through you at some stage.

Dr. Roots: Sir, I must correct that reference to responsibility of co-ordinator for all requests coming to the department. I believe the title of co-ordinator to which you refer is simply in connection with co-ordinating our response to this hearing. However, I do have some responsibilities.

The Chairman: It is too bad, because I like that title.

Dr. Roots: As to the general question of how we organize to respond to requests in the nature Senator Lang mentioned, perhaps I could refer again to Mr. Bruce, who in the area of environmental management is more close to being a co-ordinator with respect to waters and he could give examples.

Mr. Bruce: I would like to follow up on the mercury question, because I think it may be instructive to you to know how we first came upon this problem.

Senator Lang: Through the newspapers.

Mr. Bruce: No. Scientists of Wildlife Service of the Department of the Environment were the first people in Canada to find that mercury was a contaminant which was becoming a serious problem in some parts of the natural food chain. As soon as they found that, they turned to the fisheries people and informed them that the mercury in certain fish-eating birds was becoming fairly high. The fisheries people looked then at the water, and at sediment at the water bottom, in co-operation with the water part of the department. So we have through these major components of the department, the Fisheries Service who have a fish inspection program, the Wildlife Service, who look for toxic chemicals in wild life and the water service with a program to measure the quality of the water and the sediments, an early warning system for detecting things which are coming into the environment, and for finding out where they are most serious.

So that was one of the ways by which we found this contamination. Now, strengthened by the Environmental Contaminants Act to which Mr. Hurtubise referred, I think we have a lot of tools that we can bring to bear to identify problems in advance and really address them effectively on a regulatory basis, which the environment protection service is doing.

Senator Lang: My concern would be that these problems will arise at a rate in the next few years which you have not anticipated and your responses are going to have to be *ad hoc* responses to completely unforeseen circumstances and combinations of circumstances such as we discussed this morning in connection with that syndrome in the New Brunswick forest spraying situation. Dr. Roots said to me that we cannot launch research programs to meet crises. I would like to question that premise. I think that if we cannot do that we will be in very serious trouble.

Mr. Bruce: Allow me to try to answer that in one way in connection with toxic chemicals. Mr. Hurtubise has indicated we are beginning to try to put the onus now, through the Environmental Contaminants Act, on those who want to make use of the new chemicals. That is going to help. However, another longer-range kind of research program which we are trying very hard to protect might get us out of this jam. That is a program to try to find out what is the chemical structure of those contaminants which will really have an adverse impact on the environment and on human health, and how we can distinguish the chemical structure of those substances from those which are fairly benign or cause no damage to the environ-

ment. If we can really pin such a fundamental factor down effectively, then I think we have an excellent way of concentrating on those things that are likely to become problems and not be so worried about those which are unlikely to become problems. But that is a research program for which we are having a hard time getting resources to support. We are fighting all the fires, but we are trying also very hard to support the longer-range research.

Senator Lang: Yes, I can imagine that you will have a lot more to fight.

Mr. Bruce: You are right.

Senator Lang: What, if anything, has your department to do with the pollution problem caused by the dispersal of radio active waste near Port Hope? And what studies are being carried on in connection with the Mackenzie Valley pipeline project?

Dr. Roots: I can try to answer your first question; and we have other people here with regard to the second one.

Senator Lang: I want to see where that \$220 million is going.

Dr. Roots: We are very directly an active partner in an inter-departmental and federal-provincial activity with regard to the contamination in the Port Hope area. There was established in response to identification of the contaminated area of Port Hope a federal-provincial task force on radioactivity, at the deputy minister level, of which the Department of National Health and Welfare, the Atomic Energy Control Board, the Department of National Defence, Atomic Energy of Canada Limited as a Crown agency, the Department of the Environment, the Department of Energy, Mines and Resources, the Department of National Defence, the Department of Indian and Northern Affairs, the National Research Council, the Ontario Ministries of Health Environment, and Natural Resources, and, because similar things had been happening in Saskatchewan, the Saskatchewan Departments of the Environment, Labour, and Mineral Resources are all members. This task force formed a number of working groups to identify, first of all, what would be the methods by which the possibly contaminated area in Port Hope could be surveyed and identified. Another group of specialists, including medical personnel, representatives of the Department of the Environment and people who had knowledge of the movement of ground waters and soils, was considering how we would determine what would be safe levels. It is one thing to indicate what is a level known to be unsafe, and quite another to reassure a home owner or, even more particularly, a real estate agent wanting to sell a property, that there is a safe level. This was a technical problem. There was a group, which included the National Research Council, the Department of Agriculture and the Department of the Environment, who considered the long-term effects of continuing to grow vegetables in marketgarden areas in which this waste had been dumped. They was another working group on the criteria for waste disposal sites, and then there were the usual groups coordinating the groups which coordinated the groups. In the action taken, this department has provided personnel to the survey and clean-up operations in Port Hope. The overall operation is co-ordinated by a person from the Department of National Defence. The on-site technical manager is an individual from the Department of the Environment. Through the office of the Deputy Minister of the Department of the

Environment, we requested several of the services of this department to make technical people available during the summer. These are now on the job, and we will re-assess the program in the early autumn to see what is then required.

In a similar way, we have identified, through our Western Regional Board, a man to take charge of the technical operations for identifying contaminated homes, basements, golf courses, and so forth, in Uranium City.

The present situation is that while the primary responsibility for that clean-up operation is not clearly defined among government departments, clean-up is proceeding. There are many difficult decisions to be made as to who is ultimately responsible. The operation that gave rise to the contamination was entirely legal and permitted at the time. Although Eldorado Nuclear Limited was the agent, it did not do anything which was not approved at that time. Provincial agencies also had approved what had taken place. The question of responsibility is a different matter than the actual operation and clean-up, and our department is playing a technical and advisory role, and using its resources in contributing to the clean-up operation, in this case, through a federal-provincial task force.

In connection with the Mackenzie Valley pipeline, we have also an interdepartmental network of committees and agencies, which it would take some time to describe, starting at the deputy minister level and reaching to the field officer. An office was established within the Department of Indian Affairs and Northern Development in direct support of the Mackenzie Valley Pipeline Inquiry. That office assesses, from a technical point of view, the applications that have been received from the proponents. It is staffed by technical people assigned from the Department of Energy, Mines and Resources, the Department of the Environment, the Department of Indian Affairs and Northern Development, and some people who have been hired specifically for this purpose. That office and the interdepartmental committees, attempt to assemble the background information, and to make suggestions to the individual operational units of the various departments, which are mainly, in this case, the Department of Energy, Mines and Resources and the Department of the Environment. These departments conduct base studies and surveys, and assemble all the information and relate it to the information that is produced by the proponents.

In regard to federal government background action related to Mackenzie Valley questions, the policy decisions are made by a committee at the deputy minister level and a management committee at the assistant deputy minister level regarding the participation of the various departments. The technical work is coordinated by an office which is housed within the Department of Indian Affairs and Northern Development, and the individual activities are carried out by individual departmental agencies, as required. This is a rather special and complex case that has grown over the years. I think it has worked quite well. The department also provides background information assistance to the National Energy Board in its assessment of the applications in respect of the Mackenzie Valley pipeline.

Senator Lang: I have a rather raw impression, perhaps an erroneous one, from your description of these problems and the way in which they are being dealt with by the government involving two or three levels and many departments, that there is a rather fragmented approach to environmental problems that is not completely consonant with the seriousness of the subject-matters as they arise.

Dr. Roots: There is some truth to that statement. However, I think the confusion is more apparent than real. The key to eliminating the confusion is clear terms of reference for the people doing the work and exchange of information. It is true that there are, in the case of the Mackenzie Valley pipeline, many actors at many levels, and the Department of the Environment has no direct legislation in respect of pipeline operations as a whole. Although there are individual acts, such as the Clean Air Act, the Fisheries Act, and so forth, there is no overriding legislation dealing with an industrial operation such as the Mackenzie Valley pipeline, which means that the department's activities are largely technical support to other groups who must make decisions. We must endeavour to build up our ongoing background knowledge of the environmental conditions of that area to which the individual questions put by those who must make particular decisions on such things as highway and pipeline routes, or the positioning of a particular element of a pipeline, and so forth, can be applied.

Senator Lang: Do you feel the department suffers from a lack of enforcement capacity?

Dr. Roots: Not in its capacity in terms of jurisdiction and authority, Senator Lang. It does suffer from insufficient scientific, technical and resource muscle to get ahead of the immediate demands placed upon it.

Senator Bourget: Do you feel MOSST could play a role in coordinating that kind of work?

Dr. Roots: Yes, if they can give us sufficient dollars and personnel.

Senator Lang: There seems to be a general impression abroad that the permits for drilling in the Beaufort Sea were let rather hastily and without adequate consideration for environmental concerns. Do you consider that a sound proposition?

Dr. Roots: I should like to refer that to Dr. Collin.

Dr. A. E. Collin, Assistant Deputy Minister, Ocean and Aquatic Sciences, Department of the Environment: Mr. Chairman, if I may, I should like to give a brief history of that exercise. In 1973, the Department of Indian Affairs and Northern Development gave approval in principle for exploratory drilling in the coastal waters of the Beaufort Sea. The environmental conditions in the coastal waters of the Beaufort Sea are unique, in my view, because of a single factor, that being the presence of polar ice. The main environmental problem which had to be coped with in the coastal waters of the Beaufort Sea was the event of an uncontrolled blow-out of an exploratory well in such a situation where it would be impossible to provide a relief well in such a manner and in sufficient time to cut off the discharge of crude oil into the coastal waters of the Arctic Ocean.

This was recognized in the process of the granting of the permits to drill these exploratory wells. It was identified by the Department of the Environment in the fall of 1973. It was also recognized by the Department of Indian Affairs and Northern Development, which has the responsibility for granting these permits.

In the view of environmentalists, the conditions under which these exploratory wells were to be drilled were extraordinary, in that there had been no wells drilled under similar conditions anywhere in the world, and because the mechanics of controlling a well under such a

situation were not known; also, that the engineering capability available to anybody to drill these wells safely under this situation was not known to be available. So this was thought to be a situation which required an extraordinary or emergency program to find out exactly what the environmental risk was. As a result of this understanding the Department of Indian and Northern Affairs and the Department of the Environment proposed to industry that no permit would be allowed for exploratory drilling in the Beaufort Sea until such time that we had possession of at least background information as to the environmental conditions in the southern area of the Beaufort Sea and some clearer estimate as to how we would cope with an extraordinary environmental impact such as a blowout in the wells.

The research program was undertaken in the summer of 1974 and 1975. It was funded by contributions from the federal government and private industry and the industries involved in the drilling: So that the private sector contributed to the cost of the work, government contributed to the cost of the work, and it was recognized that no approval to undertake the exploratory drilling would be available until this environmental review was undertaken. In the process of the movement of this submission to drill through Cabinet due attention was given to this environmental reconnaissance. In view of environmentalists, and in the view of the department, and especially the departmental managers who had to put the program in place, the timing of such a major operation in the field in the Arctic, using ships, aircraft and many people, and the management of a joint industry-government exercise costing upwards of \$10 million, was very short.

Senator Lang: And inadequate?

Dr. Collin: It was designed as a reconnaissance environmental survey, and, as such, I think it served quite a useful purpose in arriving at the permit decision.

Senator Bell: Mr. Chairman, did he really answer that question about it being adequate?

The Chairman: It is probably too political. The witness has already said it was very short.

Senator Lang: I don't want to monopolize the questioning, Mr. Chairman but—

Senator Stanbury: I wasn't sure whether that was a little braggadocio or whether he was saying, "We did it well and we did it quickly," or whether it meant that it was a little too short.

Dr. Collin: I would welcome an opportunity to enlarge, Mr. Chairman, if that is required.

The Chairman: If we have time at the end, perhaps we could come back to this.

Senator Lang: I don't want to monopolize the questioning, Mr. Chairman—

The Chairman: No, no.

Senator Lang: —but it seems to me rather obvious that there is a conflict of interest between resource development—it seems to be such an obvious thing that it doesn't even need to be elucidated—between resource development and environmental concerns. When the department was set up forestry and fisheries went into the complex. They are both, of course, resource development concerns as

opposed to environmental primacy and environmental concerns. To what extent has the resource aspect of that been denigrated?

Dr. Roots: Mr. Chairman, I don't think that we believe—

Senator Lang: Perhaps Dr. Weir would like to answer that one.

Dr. Roots: —that there is a basic conflict in the medium on long-term between the environmental interest and resource development. There definitely is often conflict on the short term. If the object of resource development is to make as much money as one can by using the resource immediately, then undoubtedly this is a conflict with the sustained productivity of a biological based resource, and it leads to conflict with the sustained economy and usefulness of what benefits can be gained from a non-renewable resource. But in the long run—and we are finding every year that the long run is becoming shorter and shorter—the need to develop our resources in such a way that the productivity is sustained year in and year out throughout the variations of nature, despite the machinations of man, is becoming more apparent. So one of the technical and educational jobs of our department is simply and directly to identify where it is that resource development and environmental concerns are in conflict as they sometimes appear at present, and why and over what time scale; and where it is that the maintenance of a highly productive environment is directly the basis for long-term resource planning. We feel it is our job to go at this not from an emotional or conviction aspect, but to look carefully at what are the facts of the situation as we understand them at present.

We fully know that many of the resource extraction and resource using industries and mechanisms, that we have in this country at present, cannot continue in their recent method of operation without causing a great deal of environmental damage which will ultimately destroy the resource on which they depend, or so increase their costs as to make them unprofitable; and it is our job to find out what changes have to be made.

Perhaps Dr. May can make some comments on this question.

Dr. May: Well, very briefly, Mr. Chairman, I could not add very much. I might say that I do not see any direct connection in fisheries *per se* between resource development and other environmental concerns. Development of fishery resources, by and large, with rare exceptions, does not create environmental damage of any sort. If one overfishes a fish population one damages the fish stock, but not the water or the bottom over which it exists.

I would say, just to add a point to your general response, that perhaps the greatest single area for impact on living resources, of other sorts of development, is the energy area, with pipelines, oil wells offshore, nuclear plants, and all the other sorts of things that one associates with energy development.

The Chairman: On forest inventories, for instance, where are we? I remember being told last year by a man who knows quite a bit about this situation that if Canada were prepared to meet the world demand for our share of newsprint at the beginning of the 1990's we should have started to plant trees yesterday!

Dr. Roots: Dr. Bouchier would like to answer that.

Dr. R. J. Bourchier, Director General, Canadian Forestry Service: Well, on the question of our forest resources, it is quite true that in certain areas over-cutting has taken place. Nationally, we are not cutting nearly as much as we are growing. The problem is that the areas near the mills where the wood can be moved easily have not received the attention, from the forest management standpoint, that they should have. The result is that wood will have to be moved farther to the mill, and taken from areas where it is harder to operate in, and the cost of that wood will be higher. We are not going to run out of wood nationally, but we will run out of the wood that we want, the kind of wood we want and where we want it in the foreseeable future.

The Chairman: At competitive cost.

Dr. Bourchier: That is right. It is the cost factor.

Senator Bourget: Are you working closely with the Pulp and Paper Research Institute in that respect?

Dr. Bourchier: The Pulp and Paper Research Institute of Canada is located in Montreal and its program is designed to further the technology of the pulp and paper industry.

Our program deals more with the resource, the health of the resource, the preservation of a sound forest ecosystem, if you like, for the years ahead. We know what PPRIC is doing and they know what we are doing, so in that sense there is close liaison. As a matter of fact, I am on the board of directors.

Senator Bourget: It belongs to the provinces?

The Chairman: No, it is private.

Senator Bourget: The resources?

The Chairman: Oh, I am sorry. I thought you were referring to the institute.

Senator Bourget: No, the resources. I was referring to the resources. I suppose that the provinces are doing some research on that as well.

Dr. Bourchier: You are quite right, senator. The resource belongs to the province. Three of the provinces have research programs—British Columbia, Quebec and Ontario.

Senator Bourget: What about New Brunswick? New Brunswick has a good school.

Dr. Bourchier: Yes, they do at the University of New Brunswick. The Department of Natural Resources in New Brunswick is not doing any major research on this. We have a laboratory there, and this program is designed to try to meet the resource research needs in the Atlantic provinces.

Senator Bourget: How long does it take for a pulpwood tree to grow—twenty years, 25 years?

Dr. Bourchier: In the southern United States you can grow a pulpwood tree in 12 years. This is one of Canada's problems because in much of Canada if you are talking of pulpwood trees it involves a 40 to 50 to 60 years time span. Forty is considered very good.

Senator Buckwold: I am somewhat confused and concerned about jurisdictional problems so far as your department is concerned. I would presume that almost every province has its own department of the environment, or if it does not have a specific department then it certainly has

people who are very much concerned with it. Perhaps you could explain to me how that relationship exists. Is there overlapping? Are there jurisdictional differences? Is there a duplication of research spending on the part of the provinces as against the federal department? In this whole relationship, when do you come into the picture? Do you come in only on request or do you initiate action?

Dr. Roots: The relationship operates at a large number of levels. Jurisdiction is in most case quite clear, although there are also overlaps. The federal government has jurisdiction over fish stocks in navigable waters and through the Fisheries Act the Department of the Environment gets a great deal of its operational strength. Through invoking the Fisheries Act it can do a great deal to ensure that our offshore and inland waters and river systems are maintained to a quality which I might best describe by saying that if it is good enough for a fish it might be good for people too. We have acts that deal with clean air, and there is the Canada Water Act which is directly designed to bring together federal and provincial agencies to look at the management of river basins. There are other individual acts which give the federal government jurisdiction with regard to migratory birds, for example. I do not want to go through the list of all such things here. But with those being basically the exceptions, the activities that the Department of the Environment is concerned with are either as you surmised, provincial resources such as forestry, or they are common property resources such as the atmosphere, for which jurisdiction is not identified. The provincial governments have in nearly every case instituted some sort of agency to be concerned with the environment and environmental questions. None of these has a scope or range of jurisdiction which is identical with that of the Department of the Environment. So we do have overlaps in concern. We have the situation, for example, where what comes under the jurisdiction of the Department of the Environment in the federal government may only be partly in an environmental department in a province and perhaps partly in a department of natural resources. In one province the department of mines has a direct responsibility which overlaps with ours. Mr. Bruce mentioned a moment ago the federal-provincial accords which have been assigned as the mechanism for ensuring that in certain specified area we do have a firm written agreement as to how action should be taken and how resources should be shared. By and large the proportion of general background research that is shared or applied jointly between the federal agencies and the provincial governments on general aspects is small. There are a number of individual emergent programs, however, where the federal government has combined with provincial governments to undertake joint activities. We have, for example, an agreement with the Alberta government for environmental research relating to tarsands and heavy oils. This is a formal agreement whereby there is joint funding on research. There are a number of things like that. I think the only answer I can give to the committee, and this will reinforce in many respects what Senator Lang said, is that the arrangements are worked out very largely on an *ad hoc* basis. I want to assure you at the same time that they are very rarely worked out on a catch-as-catch-can—last minute basis. These are worked out in the context of a full examination of the concerns of both provincial and federal governments, and so while the environmental decisions are not uniform with every province by any means, they form part of a pattern which we try our best to make consistent and workable.

Senator Buckwold: You feel, then, that the arrangements worked out with the provinces have been satisfactory so far as your department is concerned?

Dr. Roots: We always hope that there would be improved technical information available before decisions are made. This is only natural and we are never really satisfied, but we are learning how to work with the present arrangements, I think, reasonably well. A simple change in the jurisdictional arrangements would not eliminate our problems. Again I would like to come back to Mr. Bruce who is the man in the area that many of these questions have been focused on.

Mr. Bruce: Well, I would answer that question by saying that, yes, the working relationships with the provinces on the whole are extremely good, and we are operating in a complementary way.

Senator Buckwold: Do you ever get your wrists slapped because you moved into a provincial jurisdiction?

Mr. Bruce: Occasionally, and occasionally the provinces try to take over an aspect of the work that comes under federal jurisdiction. As an example I would mention the trans-boundary pollution problem.

Senator Buckwold: That brings me back to my question relating to the overlapping problem and also relating to the expenditures of each jurisdiction. Is that a problem? Are we in fact wasting federal money at both levels?

Mr. Bruce: I think the best way to explain this situation would be to have a huge blackboard on which we could list all of the federal-provincial committees and all of the coordinating mechanisms we have in all of the fields which the Department of the Environment deals with, and they are many. We have water, we have pollution controls, we have fisheries, we have forestry, we have wildlife. For every major activity in the department we have a federal-provincial coordinating committee, and these committees do indeed make sure that there is minimization of overlap and duplication of effort. I would not want to say that there is never any, that there are never cases in which advance consultation should have been undertaken and was not, but by and large the consultation mechanisms are very strong and effective, and our working relationships with the provinces are very good in this field.

Senator Bell: One of the jurisdictional conflicts that is of great concern to us in British Columbia is the British Columbia Court of Appeal decision which puts the Georgia Strait water in the hands of the province. There is, of course, some concern whether the federal government will appeal this decision to the Supreme Court of Canada. I would assume that would be strictly within your environmental concern, because I believe this is how the situation cropped up in the first place. Would you, with the coordinating ability that you have just been explaining to Senator Buckwold, have some way of influencing what will undoubtedly have to be a political decision about whether the federal government does appeal that decision? Would you be going into that from your end of it too?

Mr. Bruce: I think that is more Dr. Collin's field than mine.

Senator Buckwold: You had better get a lawyer, not a doctor.

Dr. Collin: I would think so, Mr. Chairman.

Senator Yuzyk: It seems to me that the provincial and federal governments are each trying to accommodate one and another, but in the end who has the final authority over environment and ecology?

Mr. Bruce: I think the answer to that is that neither level of government has the final authority overall. In a specific case the Federal Fisheries Act, the Environmental Contaminants Act or the Boundary Waters Treaty may be the governing piece of legislation. In many cases the provincial legislation is the governing piece of legislation.

Senator Yuzyk: But they could be in conflict.

Mr. Bruce: They could be. The situation, with almost all aspects of the environment, is that it is a field of split or joint jurisdiction, so these co-ordinating mechanisms are necessary to make the two levels of government work effectively together in a field of joint or shared jurisdiction.

Senator Buckwold: That is really what I was trying to get at. I gather from your response that it seems to be working.

The Chairman: We don't know why.

Dr. Roots: We do not pretend that it works without friction, but I think on the whole it does work. One saving grace is simply that the total capacity of both the provinces and the federal government, and of the country as a whole, to produce information on which decisions are made is so small that we just cannot afford to duplicate. The number of people who can provide information, if we come back to our main theme of scientific aspects, is so small that if there is someone in a provincial government equipped and able to provide information which the federal government departmentally would like to have, we are more than anxious to have him do the work.

Senator Buckwold: That is a practical question. Your department federally is concerned with waterways, especially with fish and that type of thing. I guess the St. Lawrence system is one. Who would have authority over the City of Montreal to stop them putting raw sewage into that river, the provincial government or the federal government?

Senator Bourget: They have a board in Montreal.

Senator Buckwold: I am not asking why it has not been done.

The Chairman: I do not think it is fair to ask that question. I can tell you that it has to be the provincial government.

Dr. Roots: Action would have to be taken because there was contravention of some existing piece of legislation. If it could be definitely shown to be in contravention of the Fisheries Act, then the federal government could take action.

Senator Buckwold: They would have that authority.

Dr. Roots: If it could be shown to be a specific danger to health, the Minister of Health and Welfare may have grounds to take action. Similarly, there is applicable legislation under the provinces.

The Chairman: I am not too sure on that last one. I think the provincial department of health would have priority.

Dr. Roots: Agreed. The point is that action would have to be taken under a piece of legislation.

Senator Buckwold: I am only using this as an example.

Dr. Roots: There is no blanket authority for the environment.

Senator Buckwold: It would be a difficult situation. The federal government might find it harmed some marine life or created certain health problems, yet the provincial government may not be prepared to act at that given time. I can see how this is a jurisdictional problem.

Dr. Roots: There are some cases of that, yes.

The Chairman: There are quite a number of other questions on research and development that we have, and we have only 25 minutes left.

Senator Buckwold: There was another comment, if you would not mind that matter being completed, Mr. Chairman.

The Chairman: I will allow the answer. I would not like to devote the last 25 minutes to federal-provincial relations

Mr. Bruce: If I might follow up the question that has been asked, it might be useful to understand what we are doing about the St. Lawrence River. What we have is a joint cost-sharing program to investigate all of the sources of pollution to the St. Lawrence River, and what is the most cost-effective and best water quality management plan for that river. This is being done jointly between the federal government and the province. Once we get that plan together, in the next year or so, we expect to have an implementation agreement which will combine the federal and provincial powers to implement the control measures needed. That is the way we try to work through this jurisdictional tangle.

The Chairman: After separation I can guarantee you it will be more polluted! I have a few questions, going back to research and development and your research activities. I am still confused about the figures. I remember that back in 1968 we were confused by figures, and I still am. For instance, on the first page of your preamble you say that the total departmental science expenditures in 1975-76 amounted to about \$220 million, and that outlays on related scientific activities, excluding R&D, amounted to about \$140 million, leaving approximately \$80 million for R&D. However, the 1975 survey carried out by Statistics Canada, and made available to us by MOSST, shows that Environment Canada spent, in 1975-76, \$117 million on R&D as opposed to your \$80 million. How do you account for that difference?

Dr. Roots: Mr. Chairman, may I ask Dr. Hotz, our numbers man, to answer that?

The Chairman: I would also like to know if the total figure for R&D includes the budget allocated to the Fisheries Research Board.

Dr. M. C. B. Hotz (Director, Integrated Programs Branch, Department of the Environment): To answer your last question first, the Fisheries Research Board, insofar as operational natural science expenditure is concerned, no longer undertakes any work. The projects Dr. Weir was talking about earlier are investigative ones. The system has changed.

With respect to the discrepancies in figures, I did not catch some of the earlier ones you gave, but I seem to remember that you said in 1975-76 research development expenditures given by the Minister of State for Science and Technology was \$117 million.

The Chairman: Yes.

Dr. Hotz: We are showing here \$109 million in R&D, and in natural sciences, plus human sciences.

The Chairman: I was speaking only about natural sciences. In your brief, if my arithmetic is correct, you say that you are spending \$140 million. This is on the very first page, table 1, related scientific activities excluding R&D. You say that your total science expenditure budget is \$220 million.

Dr. Roots: The essential scientific or technical public services in table 1 are not just related scientific activities. These are activities which include activities that would be called research under the MOSST definition, but which are applied to the provision of public services.

The Chairman: You see the footnote: "excluding all necessary research specifically related."

Dr. Roots: This is correct. What we are trying to identify in table 1 are the scientific activities that we need to carry out in order to meet the demands for public services. It does not include the research required to improve those services and technology development in its traditional sense. Our problem is, as I tried to explain in my comments earlier, that the definition used by MOSST and Statistics Canada includes in its "science" some of the things we are doing with monitoring water systems and so on.

The Chairman: So that your figures are given because you use different methods.

Dr. Roots: Different categories. This is the essential scientific and technical public service.

The Chairman: But why do you use a different system?

Dr. Roots: Because we have no discretion; we are not using a different system. The table that Dr. Hotz has given to you breaks our total scientific expenditures down into research and development and related scientific activities; but in my presentation to you, and in Table I, we want to show those scientific and technical activities which the department does as a public service, rather than as investigative science to improve our understanding of nature and to create new technical processes and so on.

The Chairman: I wonder if we could have those figures printed as an appendix? This is a breakdown of total expenditures by the department and I have not seen this in your presentation.

Dr. Roots: It is not part of it.

The Chairman: It shows these expenditures from 1970-71 to 1976-77. Of course, these last are just forecasts, I presume? Is this agreeable?

Senator Yuzyk: I will move that the table be included with the proceedings as an appendix.

Senator Bourget: I second the motion.

The Chairman: Is it agreed, honourable senators?

Hon. Senators: Agreed.

(For Appendix see pages 16:31-16:33)

Dr. Hotz: On the second page of the comparison statement you have just received you will find comments on deflation of expenses to constant dollars, and these have been applied to the figures.

The Chairman: We will reprint these four pages. You were saying that you are one of the departments which is the most involved in contracting out. When we compare your budget, we see, for instance, that from 1973-74 to 1975-76 intramural R&D for your department increased by \$22 million and the portion attributed to Canadian industry rose by only \$3.6 million, the share received by universities increasing by \$429,000. Do you think that no other department does better than that?

Dr. Hotz: Mr. Chairman, unfortunately the figures you have before you are the figures for contracts let through the Science Centre of the Department of Supply and Services. They do not include the figures for the contracts that had been let through the Data Processing Centre. They also, more importantly, do not include contracts let by federal-provincial boards, which could only be identified through the Grants and Contributions vote, which we have only recently audited, so I cannot give you statistics on that one going back very far in time. However, I do know that in one particular area the amount last year was \$18.8 million, so that our total external contracting is, in fact, of the order of \$42.5 million. This has increased from a figure of—I could not be exact here, because of the reservations I have just put forward—but I would guess they were of the order of approximately \$3 million in 1970-71. This has been an increase, then, from somewhere like \$3 million to something of the order of \$40 million over the six years.

The Chairman: But we are here in a very difficult position; the only figures available are those I have just given you. Then you come here and give us a totally different estimate of the situation. I certainly believe in your figures, but where are they available?

Dr. Hotz: This is a problem we have had, sir, to some extent with the Ministry of State for Science and Technology and, in fact, we have discussed the presentation of these statistics with them and with Statistics Canada for quite a few years. We have not been satisfied with the presentation of these statistics, because they have not shown us in quite the right sort of light. It has only been during this year that we have been able to identify the total dimension of our external contracting. I am sure that this will be reflected in the publications that are to come in the future. Whether it would be worthwhile to go back to try to audit the Grants and Contributions votes over the last several years, I think is somewhat questionable at this time.

The Chairman: I am more interested in the future, as you know, but I am glad to hear that at least there will be a better co-ordination, at least on figures, from now on. If we are asked to analyse and assess the impact of the "make or buy" policy and we use the figures provided by Statistics Canada and MOSST, which are totally different from yours, we will arrive at wrong conclusions and will be accused of being wrong.

Dr. Roots: If I may interject, Mr. Chairman, it is a matter, in part, of the definitions used for research and science, and we have been discussing this with Statistics Canada and MOSST for some time. As Dr. Hotz has stated, under the present definitions, if they are applied objective-

ly, as they must be, some of our activities are in and some are out. They do not, in our opinion, give a very complete picture of what we are doing. This is part of the problem of technical operations in connection with the environment. It is not research in the sense of laboratory research for the development of a new product. We feel we have overcome many of the problems in the last few months, and MOSST, DSS and Statistics Canada seem to be quite happy with the compromise definitions that will be used in the future.

The Chairman: But for the purposes of preparing our report, would it be possible to get some kind of reconciliation between the two bases?

Dr. Hotz: I think this is coming about, Mr. Chairman, because the document that has been used to provide the base definition is an OECD publication known as the Frascati Manual. OECD has become dissatisfied with the manual and has decided to revise it. Both MOSST and Statistics Canada are aware of this, and I think they are a little loath to take action unilaterally at this point in time when the Frascati Manual itself is about to be revised. I think we are going to get over these difficulties in the next little while without any problems.

The Chairman: But would it be possible, for example, to make some reconciliation in respect of the year 1975-76 between the figures which are publicly available from Statistics Canada and MOSST and your method of calculating the same data?

Dr. Hotz: I do not think that is a particular problem. I think, also, that the figures that MOSST and Statistics Canada have used, have been those that have come from the Science Centre of the Department of Supply and Services. We have no arguments with those figures. It is just that they do not reflect contracts that DSS does not write.

The Chairman: We understand that the basis for calculations used by the Department of Supply and Services is not the same as that used by Statistics Canada?

Dr. Hotz: I think it is somewhat more complicated than that, Mr. Chairman.

Senator Bourget: We had the same problem in 1968 with Atomic Energy. At that time Dr. Grey said that the figures that were presented to the committee at that time did not represent the actual amount of R&D that was carried out in many government departments. He suggested that the accounting system be changed.

The Chairman: I was under the impression that as a result of our hearings in 1968 and 1969 an interdepartmental committee had been created and that peace had been established.

Dr. Hotz: I think peace has been established, Mr. Chairman. The interdepartmental Committee on Scientific Expenditures does exist and does meet. In fact, it is going to meet very shortly.

The Chairman: But no treaty has been signed as yet!

Dr. Hotz: It is a matter of how things are reported by the various departments. We do not argue with the \$20.2 million that is shown as our contracting through DSS. We can say that MOSST has perhaps ignored \$3.5 million worth of data processing contracts that have gone out through another part of DSS. That is something that we can rationalize very easily. The \$18.8 million that is not shown is not, in fact, expended directly through the line operations of

the department. Where you have a federal-provincial agreement—for example, for a water basin study, as we discussed a little earlier—the federal government assigns resources to support that agreement, and those resources come from the Grants and Contributions vote. The provincial governments provide resources as well.

The board of management, which is set up under the agreement, then proceeds to let the contracts. These are, without question, science and technology contracts let us not go beyond that kind of definition at this time. These contracts are let to the private sector, but they are not let through the Department of Supply and Services. They appear in the Grants and Contributions vote, which is completely separate and is not generally looked at except insofar as the area of university grants for research is concerned. That gets picked up, but the other dimension does not, because it goes as a contribution to a federal-provincial joint agency. It is a matter of refining our techniques a little bit, I think.

The Chairman: I do not think we have made much progress. I am even more confused now than before. I thought I was totally confused.

Do you feel that forest products labs belong to your mission?

Dr. Bouchier: Mr. Chairman, I thought that this subject might come up. It is close to the bell.

The Chairman: There is no bell.

Dr. Bouchier: First, let me start by saying that I think there is often a misconception about the forest products laboratories. I don't think they are the hand-maidens of industry if we are looking at the big companies, the big pulp and paper companies and the big companies that have both pulp and paper and integrated lumber operations. The forest products laboratories do have research projects in their programs that are designed to find a new product, to find a new use, and in that sense they are designed to help the industry, but the industry they are helping is a small diffuse industry of about 9,000 sawmills in Canada. It is comparable, in a sense, to the agricultural industry, where you can take it down to the individual farmer if you wish, and also in a sense the fishing industry which, again, is diffused down to small operating units. So the R & D that these laboratories do is aimed at product development and better use of a resource. It is aimed at an industry—

The Chairman: But it is designed to help a sector of manufacturing industry.

Dr. Bouchier: That is correct.

The Chairman: Not primary industry?

Dr. Bouchier: Yes, but it is at the first level of manufacturing. There is another role that the Forest Products laboratories fulfil, that has to do with standards. For example, there was an instance where the West German industry would not accept our plywoods. They would not accept Canadian plywoods that were certified by the industry itself, but plywoods are being sold in West Germany today because of a third party, the Forest Products labs, an independent party, said it was acceptable plywood to a standard. So there is a role, I think a legitimate government role.

The Chairman: Well, I am not questioning the government role. I am questioning the location of these labs in the

Department of the Environment and I feel that as far as I am concerned, at least, they might perhaps be better located in NRC, or somewhere in that area, rather than in the Department of the Environment. I would be prepared to make an exchange with you and to send you the Atomic Energy Control Board, which belongs much more to Environment than it does to Energy, Mines and Resources, and which is in conflict with Atomic Energy of Canada Limited.

Dr. Bouchier: There is a further point though. The forest industry is concerned with the wise use and the preservation of the forest ecosystem. There are components in the forest ecosystem that are being used, and the fact that they are not being used presents a difficulty to the management of that ecosystem.

There are poor hardwoods in western Nova Scotia that, if they were gone, you would be able to get better hardwoods. What is required is a market to get rid of those poor hardwoods, to get better hardwoods coming along and achieve a proper mix of the forest.

Now new products can be developed to use those poor hardwoods, and it is that kind of tie to the resource management issue that makes me think that there is justification for having the Forest Products laboratories as part of Environment Canada. It is tied to the wise use of resources. As Dr. Roots has said, resources and environment are very closely allied. There are not two opposing sides to the argument.

The Chairman: Well, I am not convinced; and I am frustrated because it is 5.30. I have quite a number of questions. Perhaps the last one. There was a study made by Dr. Whitehead and a colleague, I think, on the information system used by your fishery research operation, and it was discovered at some stage that the information system to transfer the results of the research for potential users, not the scientists, but for potential users, was very poor. I think you have a copy here. I don't have it here, but I was rather surprised to see this conclusion reached in 1976, when we made the same queries and comments back in 1968, and I was wondering why it took so long to realize that gap which we had discovered in '68.

Dr. Roots: I would ask Dr. Weir to comment on that.

Dr. Weir: Well, Mr. Chairman, this is one of the Board studies that I referred to at earlier. We contracted with the Atlantic companies and Whitehead to do the work. In order to complete our rough estimates of the research picture, we felt we should have a look at the scientific technological systems. That resulted in the first report, and I might say to you that we have commissioned that organization to provide us with alternatives and to give us some idea of the estimate of costs of these various programs, as well as whether you need a system that is the best you can get, or whether you need a system that serves the most useful purpose. That study will be finished by mid-September. It is that study, along with others, that we are incorporating in the overview of research and development in fisheries and the aquatic area. As well, we have a study under way on scientific resources and the resource facilities needed to support the recommendations that we make.

The Chairman: I remember also that back in 1968 we had suggested that where this was possible the results of research done in the field of fisheries as well as others should be patented, and I remember that at that time the chairman of the Board said that this was the first time it had been suggested to him. I wonder if this suggestion has

been followed up and if many patents have been taken out since 1968 as a result of the development of your research.

Dr. Weir: I cannot really say off hand. I know there is a possibility of patents being taken out in other areas. Perhaps I could ask Dr. May about that.

Dr. Arthur May, Acting Director-General, Resource Services Directorate, Department of the Environment: Mr. Chairman, in the great bulk of research in fisheries and research related to resources and resource management, patents are really not an issue. There is a relatively small research program in production and processes, and in that area patents are a possibility, but it is not an area that I am close to and I am not aware that there has been any significant increase in activity in that area at all.

The Chairman: I am not at all sure that I remember the case well, but I seem to remember that as a result of not

having taken out a patent on some equipment developed by the Board, the Germans were using that patent and probably selling us this new equipment in Canada. Would you have a look at that?

Thank you very much, gentlemen. I am sorry this session was too short—at least for us.

I would like to add just one short comment. In volume 2 of the brief of the department there are detailed comments on the recommendations made by this committee in volumes 2 and 3 of its report, and I don't know who prepared that, but with regard to a number of those recommendations you reacted negatively. However, I want you to be aware of the fact that they have been accepted by the government. That was the only comment I wanted to make in case you did not know it.

The committee adjourned.

Appendix "29"

DEPARTMENT OF THE ENVIRONMENT
SUBMISSION TO THE SENATE SPECIAL COMMITTEE ON SCIENCE POLICY

Preamble

The Department of the Environment was created in 1970 by amalgamating units from four government agencies with the then Department of Fisheries and Forestry. These units had responsibilities for a diverse group of renewable resource-related activities and performed a number of essential public services that were not altered by the Government Organization Act 1970. Table 1 shows how these essential services continue to make heavy demands on the Department's scientific expertise and financial resources.

TABLE 1

DEPARTMENT OF THE ENVIRONMENT

ESSENTIAL SCIENTIFIC OR TECHNICAL PUBLIC SERVICES
(EXCLUSIVE OF ASSOCIATED RESEARCH)
1975-1976

RESPONSIBILITY	MAN/YEARS	EXPENDITURES (approx.)
Public and specialized weather forecasts	2612	\$60.2M
Stream flow and flood forecasting	N/A	5.8
Water quality network	125	2.7
Air quality control	160	4.0
Migratory birds regulation	N/A	.3
Hydrographic survey and charting	456	10.7
Fisheries regulations and inspection	1440	35.7
		<u>139.4</u>

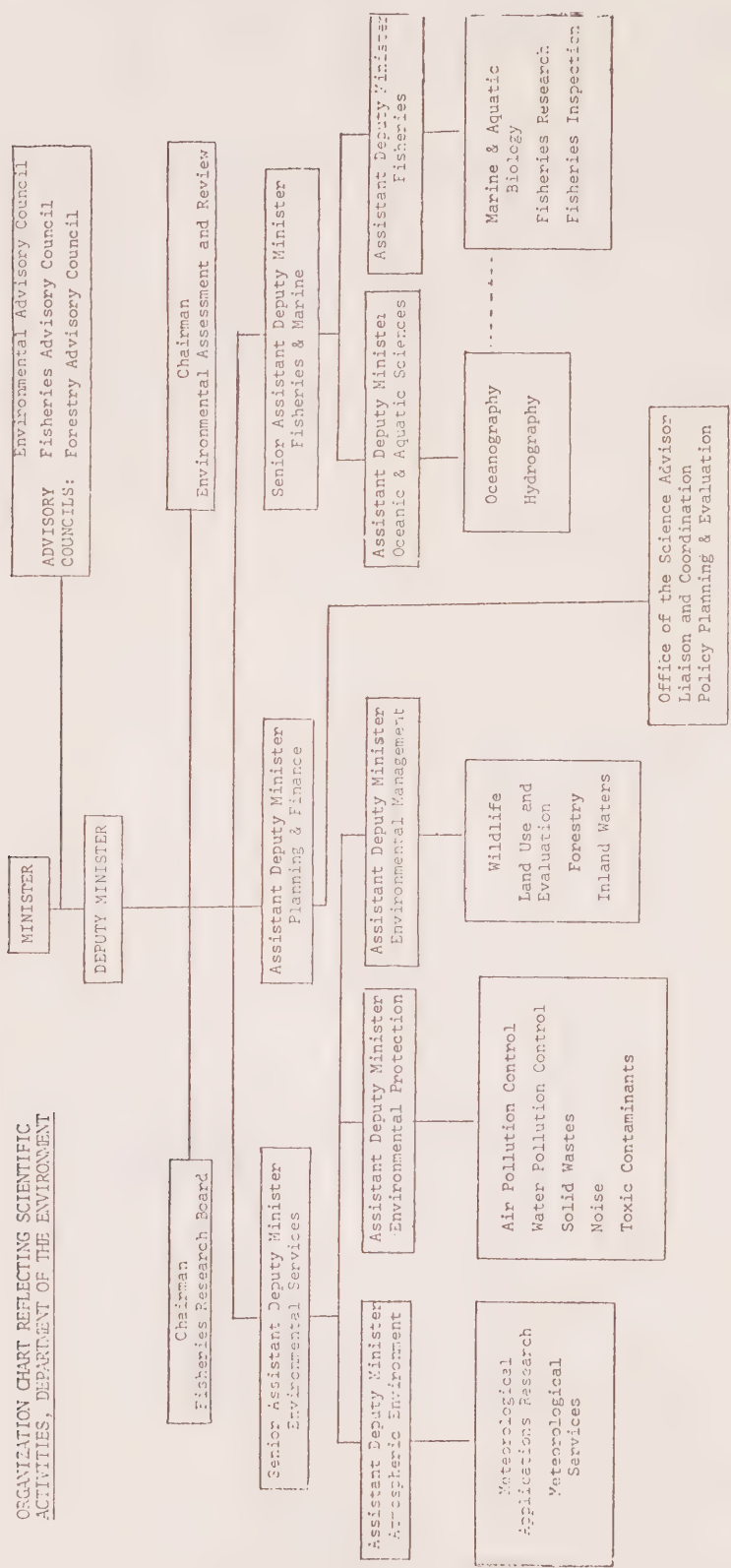
Of Departmental science expenditures of \$220 million and 5,650 man/years, these operational public services consume 65% of the financial and 70% of the manpower resources, exclusive of necessary research specifically related to them.

The structure of the Department provides for two major groups (Fisheries and Marine Services; Environmental Services), each headed by a Senior Assistant Deputy Minister, with the operational Services reporting through them. The Assistant Deputy Minister (Planning & Finance) reports directly to the Deputy Minister, as do the Chairman, Environmental Assessment and Review, and the Chairman of the Fisheries Research Board. An organization chart is attached showing the relationship of the scientific activities within the Department as of January 1976 (Figure 1).

Science policy in the Department may be considered essentially to be the use of science and technology to support the Department's mandate, i.e., the maintenance of certain essential services mainly of a scientific nature; and the development of the knowledge and policy approaches considered essential to formulate and implement the orderly management of the use of the Canadian environment. The latter involves concept and systems development, and guidance to other agencies by providing knowledge and information that will permit responsible agencies and governments to establish nationally compatible systems.

Figure 1.

ORGANIZATION CHART REFLECTING SCIENTIFIC
ACTIVITIES, DEPARTMENT OF THE ENVIRONMENT



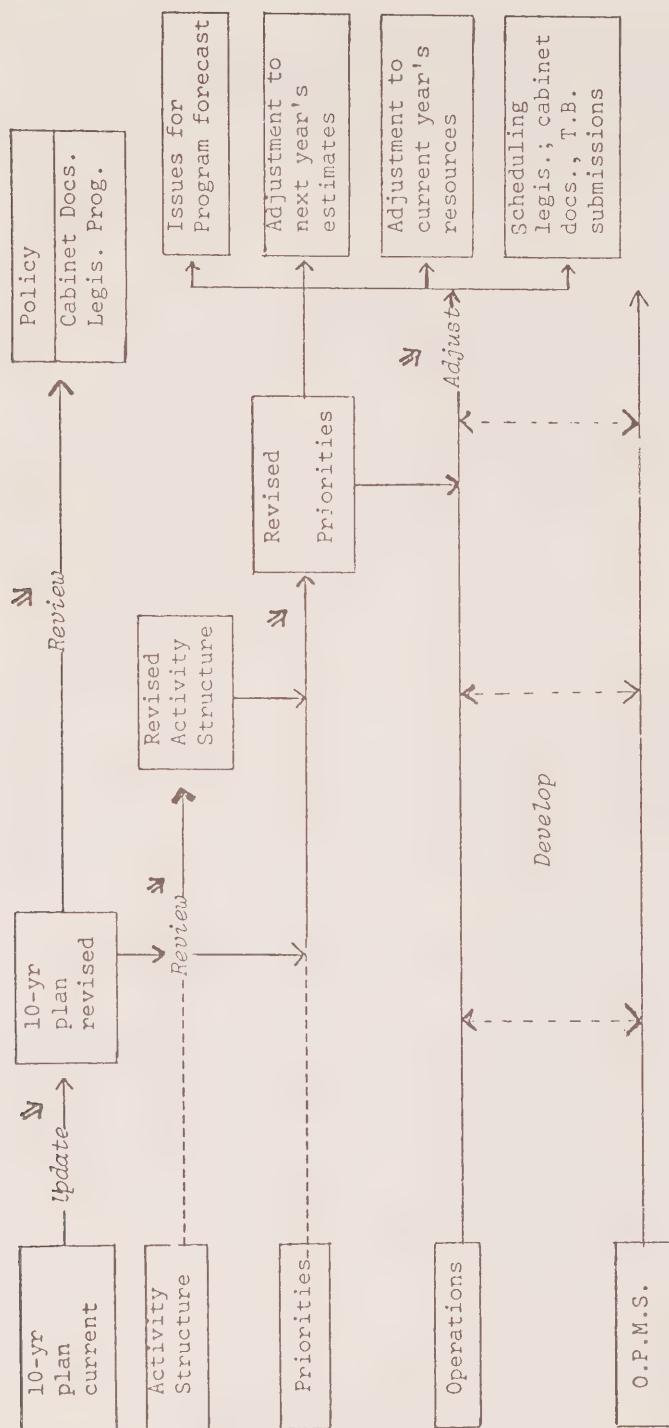


Figure 2 - PLANNING SYSTEM - DEPARTMENT OF THE ENVIRONMENT

Increasing attention has been given to contracting some of the Departmental scientific activities and the value of contracts let rose from \$1,600,000 in 1970-71 to \$14,800,000 for the first nine months of 1975-76, a rate that might reach \$20,000,000 for the fiscal year. The contracting program was fully instituted under its present terms only in 1973-74, and it is too early to evaluate its effectiveness for achieving departmental science objectives. It is hoped to launch such a study during 1976-77.

Table 2 indicates the scientific and professional establishment of the Department in 1975.

TABLE 2

Scientific and Professional Personnel, Department of the Environment
(as of August 31, 1975, by Categories)

	Planning & Finance	Environ- mental Management	Environ- mental Protection	Atmospheric Environment	Fisheries & Marine	TOTAL	%
Biologists	1	100	53	-	226	380	13.0
Chemists	-	39	32	-	54	125	4.3
Economist/Statistician	27	94	7	-	55	183	6.3
Engineers	5	137	184	7	80	413	14.2
Forestry Officers	-	91	-	1	-	92	3.2
Library Science	12	9	-	5	6	32	1.1
Meteorologists	-	-	-	625	-	625	21.5
Physical Scientists	7	89	13	7	51	167	5.7
Scientific Regulation	-	-	2	-	91	93	3.2
Research Scientists	3	381	8	62	220	674	23.1
Research Managers	4	65	8	4	25	106	3.6
OTHER	4	3	2	-	14	23	0.8
TOTAL	63	1,008	309	711	622	2,913	100%

For the Department as a whole, the largest categories are:

Research Scientists	674 or 23.1%
Meteorologists	625 or 21.5%
Engineers	413 or 14.2%
Biologists	380 or 13.0%

EMS employs the largest group of scientists, i.e., 1,008 or 34.6% of which 381 (37.8%) are research scientists.

F&M employs 622 scientists - about one quarter of these are research scientists and about one quarter are biologists.

Science policy in the Department of the Environment has tended to develop in two ways:

a) by inter-Service, multidisciplinary responses to specific environmental questions leading to the formulation of policy alternatives. These responses have mainly risen from lead groups within the Services, utilizing input from other interested parts of the Department and other government agencies as required. For example, such studies included those related to the Mackenzie pipeline, Beaufort Sea offshore drilling, James Bay hydroelectric development, etc. Experience arising from these studies contributed to the formulation of the Environmental Assessment and Review Process (see ATTACHMENT X-h).

b) by individual Services, responses in an environmental context to increasing concerns related to comprehensive regional studies, leading to policy development. These include, for example, river basin and major waterbody studies, such as the Strait of Georgia and the St. Lawrence estuary. The major study undertaken on the Great Lakes has led to cooperative agreements between Canada and the United States, and further work is continuing in response to increased knowledge. Oceanographic studies have highlighted the need for more effective coastal zone management.

The Office of the Science Advisor and the Policy Planning and Evaluation Directorate work with senior management and the Services to identify and develop those program thrusts which will be required to influence the direction of departmental and government policies. The detail of program development and implementation is the responsibility of the Services, subject to review by broadly-based interdisciplinary groups.

The Department's Planning System for annual priority setting and resource allocation is currently based on updating a Ten-Year Plan (ATTACHMENT X-i) and is shown schematically in Figure 2.

Three Councils (Canadian Environmental Advisory Council, Canadian Forestry Advisory Council, Canadian Fisheries Advisory Council), whose members are external to the Department, have been established to assist and advise the Minister in the fields of forestry, fisheries and the environment in general. The independence, expertise and regional representation of their membership permits objective assessments of Departmental (and governmental) policies, attitudes and procedures. The Environmental Advisory Council, in particular, has concerned itself with a study of the environmental policy-making process, with improvements in the Environmental Assessment and Review Process, with environmental codes for northern projects and with the availability of funds for non-governmental interdisciplinary research programs (ATTACHMENTS X-g, X-h).

When the Department was established, most of the component units had some form of university grants systems, and a study was undertaken to consolidate them under uniform guidelines and objectives. Treasury Board approval was subsequently obtained for this program, which replaces grants by research agreements, emphasizes liaison between department staff and recipient institutions, and places emphasis on relevance criteria in proposal evaluation. This system has been in operation for nearly two years, and a recent evaluation is described in ATTACHMENT VII-e. Among the problems encountered in developing this program have been apparent low priority given to rationalization of the support of university research by MOSST, and the pressure on available funding which has declined from \$2,432,000 in 1971-72 to \$1,934,000 in 1975-76, a period of continuing cost inflation. The Office of the Science Advisor has developed a method of determining the deflated purchasing power of the current scientific dollar, based on the Gross National Expenditures; in terms of this index, the 1975-76 subventions budget is worth only \$1,370,000 in 1971-72 dollars.

Response to the questionnaire

The specific responses are contained in Volumes I-III (See List of Attachments) and vary in style and completeness. They present a reasonably complete picture of scientific activities and the formulation and implementation of science policy within the Department of the Environment.

Publications and reports are submitted separately and are identified in the List of Attachments.

Comments on the recommendations and proposals contained in Volumes 2 and 3 of the Senate Special Committee on Science Policy are contained in Attachment VII-f.

The submission to the Senate Committee was assembled and this preface prepared in the Office of the Science Advisor.

APPENDIX "30"

COMPARISON OF DOE SCIENCE EXPENDITURES

Total DOE Science Expenditures (\$000's)

TABLE 1

	70/71	71/72	72/73	73/74	74/75	75/76	76/77	
R&D	70,828	76,137	88,311	89,875	104,626	109,807	120,447	N
	3,126	3,516	2,446	2,292	2,333	1,728	2,073	H
	73,954	79,653	90,757	92,167	106,959	111,535	122,520	T
RSA	80,245	92,306	110,074	105,759	138,940	158,384	183,645	N
	2,871	3,988	5,247	5,424	6,420	6,922	7,364	H
	83,116	96,294	115,321	111,183	145,360	165,306	191,009	T
TOTAL DOE	151,073	168,443	198,385	195,634	243,566	268,191	304,092	N
	5,997	7,504	7,693	7,716	8,753	8,650	9,437	H
	157,070	175,947	206,078	203,350	252,319	276,841	313,529	T
TOTAL GOV'T	776,525	833,489	910,988	953,018	1,061,915	1,174,079	1,290,568	N
	104,445	184,674	206,040	244,521	298,757	356,893	433,660	H
	880,970	1,018,163	1,117,028	1,197,539	1,360,672	1,530,972	1,724,228	T
GNP (\$M)	85,685	94,115	104,669	122,582	144,616	161,132	176,492	*

N - Natural Science H - Human Science T - Total

* All GNP figures are expressed in millions of dollars and the 1976 figure is the first quarter adjusted for the complete year

Growth in Federal Government spending on Science (Natural and Human) since 1970 has been \$842.26 (millions). Measured over seven years this is a 13.67% annual growth rate in current dollar expenditures. Similarly DOE has grown by \$156.46 (millions) or an annual growth rate of 14.23% in current dollars. Superficially this seems to be a very steady overall growth. However, closer examination reveals a trend which has not been continuously positive. In 1972/73, DOE compared well in terms of current dollar expenditures but in 73/74 the current dollar expenditures for DOE dropped when overall government spending on science increased by 7.2%.

Comparisons against the Canadian GNP, which gives a more objective picture of actual effort resulting from Science expenditures, indicate the resulting benefit value trend may be somewhat different.

DOE Science Expenditures as % of GNP.

Table 11

1970/71	71/72	72/73	73/74	74/75	75/76	76/77
.18	.18	<u>.196</u>	.16	.17	.17	.17

Federal Gov't Expenditures on Science as a % of GNP

1970/71	71/72	72/73	73/74	74/75	75/76	76/77
1.02	<u>1.08</u>	<u>1.06</u>	.97	.94	.95	.90

In terms of the GNP, overall DOE Science expenditures have been decreasing from our 1972/73 high and this appears to be a continuing long-term trend which is also observed for total government science.

Even more objective is analysis from a constant dollar point of view. This technique adjusts for inflation as well as incorporating parallel economic indicators, such as Gross National Expenditures. In Table III the deflated dollar expenditures on Science for DOE over the seven year period are shown to have increased by \$30M, representing an annual growth rate of 2.7%. Again, 1972/73 was the highest point for DOE Science expenditures. Likewise, total government spending has increased by \$151.5M, which is a 1.4% annual growth rate. Identical to the DOE trend, the Federal government total Science expenditures peaked in 1972/73, and have not again reached that point in constant dollar terms.

TOTAL CURRENT DOLLAR EXPENDITURES ON SCIENCE DEFLATED TO
CONSTANT DOLLARS

Table III

(\$M)	Total DOE Science Exp.	Total Gov't Science Exp.	Deflator Co-efficient (Base 70/71) N.B.	Total DOE Science Exp. Deflated	Total Gov't Science Exp. Deflated
70/71	157.070	880.970	1.00	157.070	880.970
71/72	175.947	1,018.163	1.03	170.822	988.508
72/73	206.078	1,117.028	1.08	190.813	1,034.285
73/74	203.350	1,197.539	1.19	170.882	1,006.335
74/75	252.319	1,360.672	1.33	189.714	1,023.062
75/76	276.841	1,530.972	1.49	185.799	1,027.498
76/77	313.529	1,724.228	1.67	187.742	1,032.472

N.B. The deflator co-efficient is a Laspeyeres design based on a one year constant (70/71) which measures for each year against that constant. The co-efficients used here are determined by the Implicit Price Index of the Gross National Expenditures, which are indexed against a 1961 year base.

CURRENT AND DEFLATED SCIENCE EXPENDITURES EXPRESSED AS A % OF GNP

Table IV

	DOE Science Exp.	DOE Deflated Science Exp.		Federal Gov't Science Exp.	Federal Gov't Science Exp. Deflated	
70/71	.18	.18	.00	1.02	1.02	.00
71/72	.18	.18	.00	1.08	1.05	-.03
72/73	.196	.18	-.016	1.06	.98	-.08
73/74	.16	.13	-.03	.97	.82	-.15
74/75	.17	.13	-.04	.94	.70	-.24
75/76	.17	.11	-.06	.95	.63	-.32
76/77	.17	.10	-.07	.96	.58	-.38

Difference Between Current and Constant
 Dollar Expenditures on Science as Expressed
 as a % of GNP Values

In Table IV the difference between current and deflated GNP percentages for DOE is shown to be negative for the years 1972/73 through 1976/77. The increasing rate of this negative trend is resulting in an ever-widening spread between deflated and current dollar values. This trend is also evident for total Federal Government expenditures.

It is important to note that the trend between current and constant dollar expenditures on science for DOE is not simply a case of the constant dollar expenditures being of a lesser value (quantitatively and qualitatively), but it is also divergent; constant dollar expenditures have levelled off while current dollar expenditures have continued to grow.

The trend for the Federal Government is identical to that for this department, except that current dollar expenditures have shown a much greater divergence.

JUL 19 1989

